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EDITOR:
V. G. L. VAN SOMEREN.

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THE BREEDING BIOLOGY OF CERTAIN EAST AFRICAN HORNBILL (BUCEROTIDAE).

By R. E. MOREAU, C.M.Z.S., M.B.O.U.,

East African Agricultural Research Station, Amani.

INTRODUCTION AND ACKNOWLEDGMENTS.

Bycanistes cristatus.

The Ngua nest : history 1932-1936.

The Amani nest : history 1934-1936.

The building process.

" Personal relations " between the pair during the building.

The period of nest occupation.

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Lophoceros deckeni.

The Longido nest, 1932-1936.

Discussion of the observations.

Lophoceros melanoleucos.

SUMMARY.

Although the habits of hornbills have long been recognised as exceptionally interesting, little in the way of connected observations on their behaviour at the nest has been published for any species. The first concern of anyone finding a nest has nearly always been to cut down the tree or at least break open the hole. Chapin's notes on *Bycanistes albotibialis* (1931) and Hoesch's on *Lophoceros flavirostris leucomelas* (1934) are exceptional; but there still appear to be no records through all the stages of a hornbill's nesting without interference, conclusive if not fatal, by man. Of the three species for which I am able to put forward original observations in this paper, two of them, *Bycanistes cristatus* and *Lophoceros deckeni*, have, so far as I can discover, not had their nesting described in any way before.

The fact that the present observations settle certain main questions, and in some respects approach completeness, is due to the enthusiastic co-operation I have been fortunate enough to secure. For learning the habits of *Bycanistes cristatus* opportunities have been good; one nest has been under observation for a total of about

400 hours in four successive seasons, and another for about 100 hours in two seasons. For much valuable data on this species I have to thank Mr. T. A. Baldock, Mr. L. S. V. Venables, and Mrs. R. E. Moreau, who have most generously given me all their notes. To obtain a long series of data on feeding times I employed Africans, especially an Mzigua named Simon. Their field-notes are excellent and I am satisfied that they are essentially reliable. No European could have spared the time for the dawn-to-dusk watches the Africans kept.

The remarkable facts I have to record about *Lophoceros deckeni* are nearly all transcribed direct from the notes made by Mr. S. A. Child at Longido. Three years ago I was shown a photograph he had taken of a female visiting a closed nest. Realising the exceptionally interesting possibilities I got into communication with him and suggested certain points to which he might give attention. The results are striking; and it will be realised that he is a very good observer.

For the third species, *Lophoceros melanoleucos*, mentioned in this paper, the observations I have to record are more scanty but they suffice to establish certain main points. I am indebted to Col. the Hon. M. T. Boscawen for the greater part of the data.

For chemical analyses I have to thank Dr. R. R. Worsley, and for all the botanical names used, Mr. P. J. Greenway. The plates are from Mrs. Moreau's sketches from life.

BYCANISTES CRISTATUS.*

This, the Silvery-cheeked, is the large Hornbill of the Highland and Intermediate Evergreen Forest from Abyssinia to Mashonaland. In Usambara it is very common, but owing to the great height and close stand of the trees nests are difficult to locate and observe. The birds probably pair for life, as it is the rule for couples to be seen together all round the year. At the same time they are gregarious, not only while feeding, but also for roosting. Once having established a communal roost, often in the crown of a hundred-and-fifty-foot *Albizzia*, the birds return to it, to the number of perhaps two hundred, night after night for several months, although during this period the fruiting trees, to and from which the birds flight morning and evening, may change repeatedly. The hornbills do not leave their roost until about half an hour after sunrise and they seek it again before sunset.† On the average thirteen hours out of the twenty-four must be spent at the roost, a regime apparently not modified during the breeding cycle except by the female while she is immured.

* Mr. W. L. Sclater informs me *in litt.* that the series in the British Museum does not support the differentiation of *B.c. brevis* Friedmann (type locality near Amani) on measurements. van Someren, however, admits this form (1932).

† At Amani there is only 37 minutes' difference between the longest and shortest day.

Bycanistes cristatus is almost exclusively frugivorous. I have evidence that in Usambara it occasionally eats one of the big forest millipedes and, when swarms are about, a locust. Swynnerton has recorded one at Chirinda (1907) "crammed with locusts," but there is nothing to show that this hornbill ever takes vertebrate prey, especially young birds, as do others of the family.

The Usambara forests, of which some description may be found in Moreau (1934), provide plenty of fruit all the year round and of many kinds. From our observations it is probable that the hornbills utilise them all except the smallest (such as *Trema guineensis*, the size of bilberries). They are very fond of stone fruits about as big as cherries, e.g. *Sersalisia usambarensis*, and equally of *Canthium* fruits the size of a small apple. They eat small nut-like fruits without flesh and even, it appears, the hard heavy nuts of *Odyndea Zimmermannii*, which are as big as plums. These hornbills have taken readily to some of the exotic fruits introduced to Amani, especially *Maesopsis Eminii* and guavas (*Psidium* spp.) Fruits of all kinds are swallowed whole, tossed back into the gullet from the tip of the mandibles with a jerk of the head.

Notwithstanding the equable climate of Amani and the perennial supply of fruit the breeding season is strictly limited for reasons that are quite unknown. In the five cases that have come under our observation nest-building has taken place in October and November. Five adults collected between the end of March and the end of May were all in moult. Young leave the nest between the latter half of February and the end of March, i.e. at the end of the comparatively hot and dry season and just before the break of the "long rains."

THE NGUA NEST; HISTORY, 1932-1936.

The Ngua nest was first brought to my attention by Mr. T. A. Baldock on 2/3/33. A male was visiting a hole facing east about 80 feet up in the trunk of a great "camphor" tree (*Ocotea usambarensis*) just level with the point where the first branch sprang off. The tree stood on the edge of an isolated new clearing, excellently situated for observation. In successive years the bird owning the nest showed varying, but on the whole little, concern at the presence of an observer. Most of our observations on this nest we made from a point with a little overhead cover about 100 yards from the foot of the tree.

The natural hole was an irregular oval about 15 inches high by 8 wide, probably where a limb had been dropped. It had been plastered so as to leave a median slit about 10 inches long and barely 2 wide. The material employed was smooth externally except for a few radial cracks, and it was exactly similar in appearance to the soil, pale reddish when dry, surrounding the tree.

A number of African labourers who were questioned separately agreed in stating that the male bird had been visiting the hole alone

when they were clearing the ground round the tree for the first time. Reference to the estate books established this as between 3/10/32 and 4/11/32.

One of the upper quadrants of the plaster was broken away between 25 and 27/3/33, and the birds had left the tree. It appeared then that the female must have been walled in for 159 days \pm 17.

During the latter part of 1933 both Baldock and I were in England. He returned first, at the beginning of November, and found the hole already sealed. Evidence from the sources utilised in the preceding season indicated that the female had gone in between 21/9/33 and 23/10/33. The plaster was broken between 07.00 on 20/2/34 and noon on 21/2/34. As in the preceding year the hornbills left their tree entirely and no one saw them go. A surprisingly small gap had been made in the plaster in the same upper quadrant as in 1933. The period indicated for the female's residence was 136 \pm 16 days. This is shorter than that arrived at for the 1932/33 nesting but still probably too long. The beginning dates depend on casual African evidence; and as will be shown it is easy without prolonged and careful watching to mistake the later stages of the plastering process for actual occupation of the nest.

In November, 1934, both male and female were seen at this nest. On 10/11 when the gap made in the plaster in the preceding February had been partly repaired, Venables watched the female squeeze into the hole with difficulty.

"First she clung like a woodpecker, and put in her head up to the shoulders. . . . She then withdrew and turning half sideways inserted first her expanded left wing (appeared to 'hold on' with it), then her head, then her body (much wriggling needed), and lastly her expanded right wing and tail."

On 5/12 Venables observed a most interesting incident, of which I reproduce his notes:—

- " 06.30 Observer arrived hide. Tip of female's beak frequently protrudes from slit.
- " 07.02 She pushes head right out and looks about. Presently withdraws.
- " 07.22 She starts calling loudly. Beak in and out of slit.
- " 07.24 Male arrives. Small yellow fruit in tip of bill. Sits in tree. Female forces out head, neck, and left shoulder, and calls loudly. In a few moments appears to make an effort and forces out whole body, breaking down a good deal of the wall on her left (in the same top corner as in preceding years). Drops 8-10 ft. and flies into forest followed by male. He seems to show no emotion."

The pair were seen in the neighbourhood for the next couple of hours but not thereafter. The female had been inside for 2-3 weeks. Venables noted that when she flew out she appeared to be fully fledged.

The hole was not occupied again for a year. Repairs to the plaster began on 2/11/35. On 6/11 Baldock saw what there is good reason to accept as the final entrance of the female. The pair arrived together about 09.00 and sat together for a quarter of an hour. They "began to talk quietly, not the noisy squawk, and hop about till the female went up to the hole. She went in, first one wing, then the head, and then stuck. She pushed for about a minute but could not do it, so came right out. She then had another shot and brought it off. All the time male squawking frantically." When his mate was in he went off to bring more plastering material.

Female and young emerged on 21/2/36, i.e. after the former had been inside for 108 days. Fortunately I had an African on the spot that morning with notebook, pencil, and watch. I append a verbatim translation of his account, which was written in Kiswahili.

- " 06.28 Male arrived and sat in tree till 06.41.
 - " 07.21 Male arrived and sat in tree till 07.35.
(Questioned: 'He brought no food either time.')
 - " 07.57 Wife inside began to break the wall. She half broke it enough to get her neck out and at 08.08 she rested.
 - " 08.18 He arrived, fed her 12 times and went off at 08.25.
 - " 08.56 Wife inside finished breaking the wall.
 - " 09.04 She came out and at first perched on a branch.
(Questioned: 'She did not clamber up from the hole but flew straight out and up to a high branch.')
 - " 09.11 Husband and wife went off (literally 'went for a stroll'). They returned 09.19 and settled on a branch.
 - " 09.31 Wife went off by herself, returning 09.34 and settling on a branch.
 - " 09.41 Husband and wife went off again. Their children inside. They returned 09.49 and settled on a branch.
 - " 09.58 Mother and father went off again. They returned at 10.03 and sat on the tree till 10.10. She called three times.
 - " 10.13 One child came out, one only, and sat on a branch till 10.27. (Questioned: 'The child flew straight out of the hole and with some difficulty to a branch about on a level but in the next tree.')
- Wife and husband went off together with their child towards the east. That's all. I sat there till 17.08. When I left the three had still not returned."

It may at this point conveniently be mentioned that a young hornbill collected by Baldock on 21/3/36 out of a flock weighed only 303 grams, less than one-third as much as an adult. It resembled an adult in pattern and colour except that it was browner on the forehead and its iris was whitish instead of brown. Although perfectly well able to fly none of its feathers had broken sheath on the back of its thighs nor on well-defined lines up the back and front of its neck. A juvenile on 1/4/36 was fully feathered. The shape of the bill is shown in Plate 1. Both specimens went to the British Museum in spirit.

THE AMANI NEST : HISTORY 1934-1936.

On 30/10/34 I noticed that a female hornbill was working at a hole about 9 by 12 inches 80 feet up in the bole of a big Parinarium tree in the forest at Amani. It is so closely beset with other tall trees that it is impossible to watch the hole from anywhere near the base of the tree, but a clear view of it is obtainable from about 250 yards away across a narrow valley. I had passed within sight of this hole on most days for the preceding six years and feel sure it had not been occupied during that period by hornbills. On 30/10/34 a narrow rim of reddish plaster had already been placed in the lower half of the hole. Close by, the coarse epiphytic fern *Drynaria Haudentii* had established itself on the tree trunk.

Male and female worked at the hole with varying assiduity every day for about three weeks, completing a crescent-shaped piece of plaster with its thickest part at the lower right-hand side of the hole. Between 19 and 22/11 they stopped work and for the next twelve months were seen at the nest only occasionally.

For example, on 19/12, when no male bird was about, a female came out and flew off. On 30/1/35 a pair were sitting on the boss above the hole. They kept on bending down and peering in. Eventually they flew away. Later in the same morning two woodpeckers were in and out of the hole. The hornbills were not seen there again until 9/9/35 when the male was sitting in the tree and the female entered the hole for a few moments. On 11/9 the same thing happened, but no regular visits were made by the birds and no building was done until early November. Between 14 and 21/11 they concentrated on the left hand lower side of the hole and made good progress. By 25/11 a rim of plaster had been run up the left-hand side of the hole to the top. By 28/11 the slit had almost reached its final form and the female had the greatest difficulty in forcing her way in and out. But on 29/11 they failed to visit the nest and have not done so since (April, 1936). Instead, the hole has been frequented by a pair of starlings (*Onychognathus walleri*).

It would be very interesting if the reasons for the failure to proceed with the Amani nest in both 1934 and 1935 could be ascertained, but the behaviour preceding the cessation of work is difficult to interpret. In both years building continued after copulation had taken place, and when work had ceased both birds still showed a keen interest in the nest-hole. On reviewing the daily notes of 1934, with their impression of growing indolence, I think that the breakdown in the breeding cycle may have been due to some difficulty experienced by the male in maintaining the supply of building material, a difficulty not unlikely to be connected with his salivation (see next section).

In 1935 there was every prospect that the nesting would proceed normally. The female's entrances during the last week of work were so difficult that we thought every one must be the last. Squeezing in on 24/11 she broke away a lump of plaster, an accident that did not happen on subsequent days; and on emerging that morning she had to push out one wing first. On 25/11 Mrs. Moreau saw her make two unsuccessful attempts to get out. Her head and neck emerged and waved about wildly. She managed it at the third attempt by trying wing first. On 27/11 she apparently required the male's help to get in, and it took her four minutes of furious struggling to get out. The birds' activity thereafter ceased so abruptly that I should have posited an accident to one of them were it not that a pair continued to pay occasional visits.

THE BUILDING PROCESS.

Our observations on the Amani and Ngua nests combined cover every stage from the initiation of work on a previously unoccupied hole to the completion of the walling after the female can no longer get out.

Briefly, almost the whole of the actual building is done by the female from inside the hole with material brought to her by her mate. Until the walling is well advanced, this procedure is by no means predetermined by the male's inability to get into the hole.

Our birds never worked for more than five hours. They were only once seen to arrive before 09.00 and on occasion they did not get to business until after 11.00. They always knocked off before 15.00, usually between 13.00 and 14.00. Then they invariably flew right away till the following morning. This time-table meant that they were both able to get a feed before starting work. Once settled in the hole the female as a rule sat there for the whole period, say about four hours, during which time the male only exceptionally brought her a fruit.

When the pair did not arrive together in the morning it was the male who appeared at the hole first. He then showed a comical

concern, sitting on the boss above the hole and repeatedly bending down to peer inside. On the arrival of the female she would usually enter with little delay, and the male fly off for material. From the Amani nest he was always lost to sight among the trees, but at Ngua it was possible occasionally to follow his actions in the clearing. After an interval varying up to about thirty minutes—usually not more than fifteen—he would reappear, rising laboriously either straight to the hole or first of all to a neighbouring branch. At Amani the perch from which the male passed in material was always the boss overhanging the hole, so that when he bent down he was in danger of losing his balance. At Ngua the male clung in a vertical position with his feet at the lower rim of the natural hole and his spread tail pressed against the trunk as in Plate 2, where only the top part of the slit is visible above the bird's head.

The staple building material at all stages was pellets disgorged by the male. He would bend his head down and "heave" until a pellet appeared from his throat. It would then be conveyed by a rapid chewing motion to the tip of his mandibles, in which it was passed to the female inside the hole. The movement made me think of a man trying to work some small object, a stud or a button, down inside the sleeve of his jacket from his armpit to his hand. We were struck by the care with which the male conveyed his pellets. We never saw one lost; the tips of the great mandibles held them as if in forceps; and he was not content merely to drop his pellets into the hole. The female had actually to accept the pellet in her bill before he was satisfied to relinquish it. If she was too occupied to accept it at once he would hold it in his bill and repeatedly bend down to proffer it. We have seen him do this as many as 25 times with a single pellet. Besides this he very often bent down to watch how the work inside the hole was getting on and whether the female was ready for another pellet. When he was getting impatient his see-sawing motion was laughable; almost before he had resumed his upright posture after a fruitless inspection down would go his head again for another look.

The pellets were spherical to ovoid, with diameter varying from about half to one inch. (The length of the male's casque provided a convenient measure.) The number brought up by the male at a single visit varied from 3 to 42. When working most consistently he averaged about 20, e.g. 200 in 9 visits on 30/10/34, 142 in 7 on 31/10, 217 in 11 on 1/11, 235 in 15 on 23/11/35, the last being the biggest day's work observed. Owing to the number of profferings made fruitlessly by the male when the female is too busy to accept we found it essential to watch all these actions carefully through binoculars to make sure when pellets actually passed. At the end of a pellet sequence the male often sat quietly for some time.

Occasionally the male had difficulty in producing the pellets and would try several times to disgorge without result. An extreme example was noted by Venables on 3/11/34 at 13.27, i.e. near the end of the day's work.

"Male arrives and gives 15 pellets. Much trouble to produce, e.g. five minutes' gulping with head at all angles for No. 8 and a good deal of bother with Nos. 9-15."

Since learning what his raw material is we are surprised that his difficulties are not always great. From the reddish colour of the pellets we had supposed them to consist of mud, but it was not until 6/11/35 that Baldock at Ngua made the definitive observation:—

"Male goes down on to the ground and picks up about 12 bits of earth [particularly dry at the time] and with one more in his beak flies up to nest and gives 16 pellets. . . . Off to a spot in sight where he picks up earth four times and swallows it, the last time a big beakful which he has difficulty in swallowing. Then with fifth lump in bill flies to hole and gives female the lump and 10 pellets."

This proves that the male forms pellets in his gullet, not solely by rounding individual lumps of earth swallowed, but also by dividing them by some mechanism in his interior.* The process seems to be a rapid one. We have seen the male disgorge 33 pellets after only five minutes' absence. On the other hand he once started disgorging after sitting inactive on the tree for 35 minutes, a period during which lumps of earth held in the gullet might have been expected to stick together. It should be added that the soil at Ngua, and at Amani as well, is a clay (derived from gneiss) with a considerable content of sand. It does not "bind" when moistened with water and cannot be used to make pottery. Plastering of both the Amani and Ngua nests is always done in a comparatively dry season of the year, although wet soil is available along the numerous streams. Exceptionally, Baldock observed, the Ngua male brought his material from swampy ground.

The pellets that form the staple of the plaster are not the only material used. Objects much larger than pellets were brought by the Amani male once or twice each day. We could not be certain what they were, except that they included pieces of bark of the epiphytic growths at which the birds were sometimes seen hacking. At Ngua in both 1934 and 1935 the male regularly, though not in-

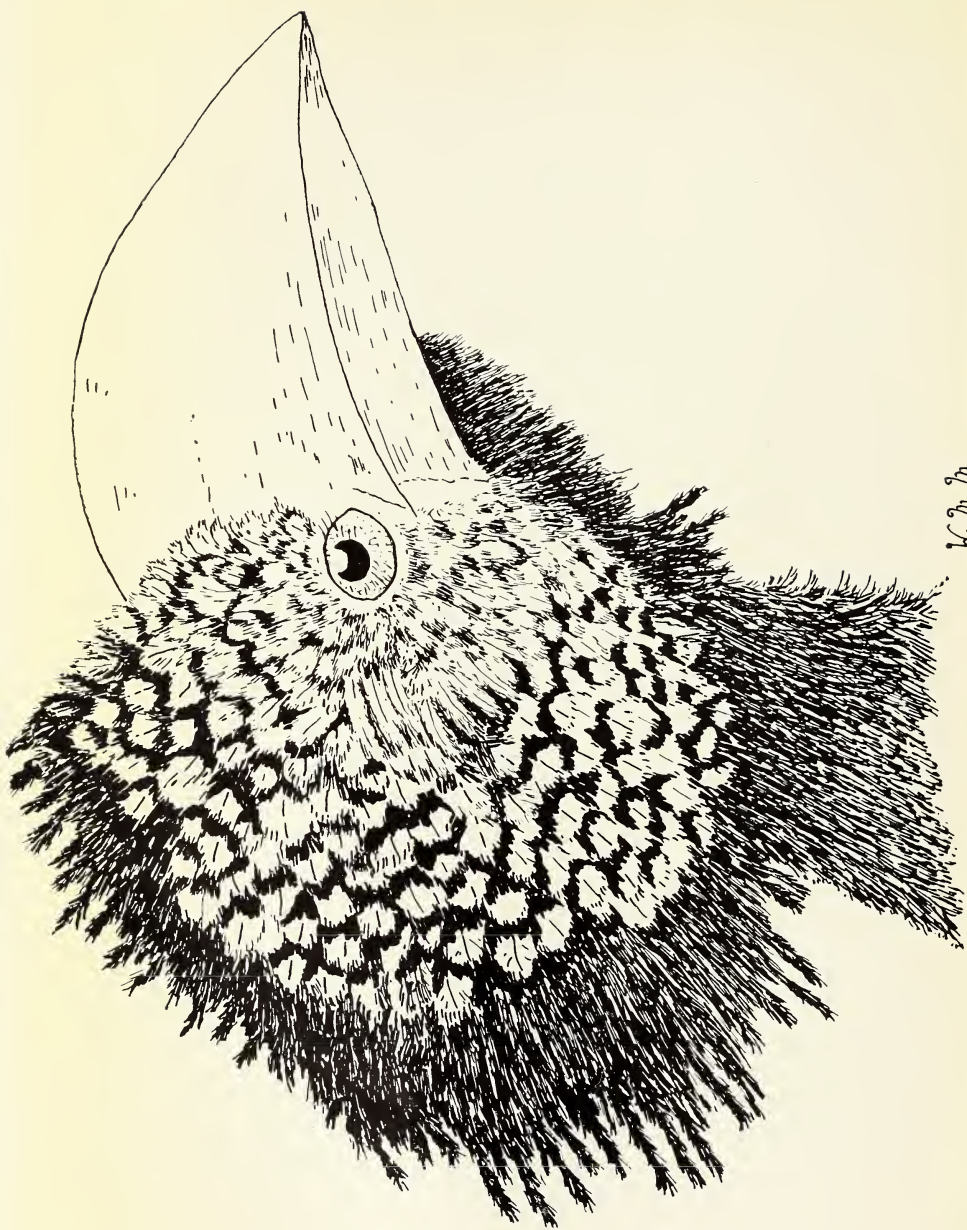
* Dr. P. R. Lowe has kindly undertaken to make an anatomical investigation of specimens brought to London for this purpose.

variably, brought something in his bill which he passed into the hole before he began to produce pellets. Thus on 10/11/34 Venables saw "moss or lichen" brought three times and a lump of soil twice. Baldock's notes on the same nest in 1935 show that a lump of dry soil was regularly given to the female before each batch of pellets. On 27/11/35 I saw the Amani male pass into the nest a stick that I estimated to be no less than 12 inches long and 2 inches thick; and Baldock once made a similar note at Ngua.

After the Ngua female had broken her way out in 1936 I obtained a piece of the plaster. It appeared to consist entirely of soil with a few bits of bark embedded in it, but it was astonishingly hard and unfriable, almost like cement. Analysis by Dr. Worsley was negative for nitrogen, including uric acid. This practically proves that there was no admixture of dung, but not so conclusively as it would in most birds, because of the unusual nature of the dejecta of *Bycanistes cristatus* (see next section). Most probably the binder that causes the rather sandy soil to set so hard is the male's saliva, and if so he must need a notable supply of it for the whole building process. As we have seen, the pellets varied between half and one inch in diameter, and when 200 were produced in the course of a morning's work—a number frequently exceeded—it can be calculated on an average diameter of $\frac{3}{4}$ inch that enough saliva would be required to permeate some 33 cubic inches of earth.

In this connection highly significant observations were made by Baldock at Ngua on 6 and 7/11/35. The female had just made her final entrance and the male was alternating supplies of food for her with cargoes of pellets for the last stage of the plastering. The food consisted of fruits which he carried in his gullet and brought up in exactly the same way as he did the pellets. Several times Baldock saw the male while disgorging at the nest let fall what appeared to be gouts of saliva; and on each occasion it was while he was disgorging a batch of fruits, not pellets. In all our observations on the feeding by the male after the plastering is finished there is no record of similar salivation. This may, of course, be due merely to faulty observation. If not, it points to an abnormal rate of secretion by the male during the building season.

The male's part was confined to "outside work," the bringing of material, except at the very beginning of operations on the Amani hole. Thus, when the female was making the initial clearance of rubbish from the interior the male sitting outside occasionally took it from her beak and dropped it at the foot of the tree. On 30/10/34 the male twice appeared to me to affix something to the rim of the nest and to press it with his casque, but this was never seen afterwards. On this date he also entered several times after giving the female pellets. From Venables' notes this happened only once on the follow-



H. N. H.

Head of young *BYCANISTES CRISTATUS* showing shape of bill.



K. M. M.

Male clinging to entrance of nesting hole.



Male and female perched above nesting hole.

ing day; and in the course of the subsequent extensive watching none of us ever saw the male enter again, although throughout the 1934 spell of building there remained enough room for him to do so and he obviously took a keen interest in the progress made by the female inside.

At both nests she was responsible for practically the whole of the actual construction. On arrival in the morning she often went straight in, but sometimes approached by stages down through the top of the tree with a curious air of circumspection. I particularly noted on the morning of 24/11/35 how when she arrived for the first time she examined the whole exterior of the nest most carefully. Then, contrary to her usual custom, she did a certain amount of work clinging to the outside with her head in through the opening.

It was never possible to observe closely the actions of a female inside the nest. When pellets were being added she could sometimes be seen to smooth and press them with the flat of her bill. But before the male had brought his first pellet of the day her head was often in active movement inside, apparently hammering and scraping.

The only important exceptions to the females' custom of doing their work from inside the hole were seen in the last stages of the building at Amani. On 24/11/35 at 14.09, when the female had emerged with difficulty, I watched her put her head in again and work obscurely inside. While in this position she accepted pellets from the male and placed them inside. After a few minutes' flight together she settled again outside the hole and I noted :—

“ She works from outside as before. Withdraws head with a lump of plaster quite two inches in diameter. Moves to upper boss working lump in mandibles. Bends down as if trying to replace lump. Then jumps back to lower edge again. Male comes to boss and leans down as if to take the lump from her, which she then lets fall to the ground.”

On 28/11/35, the last day they worked at all, she did it first from within the hole, and then, forcing her way out, from outside, I noted :

“ 12.50. Male arrived with large red lump apparently soil. Sat on boss alongside female. She accepted the lump and swallowed it. Male then produced seven pellets which female took and, bending down, added one by one to the walling with a rapid rivetting motion of the head. After peering about inside the hole she hacked off lumps of the brown basal part of the epiphytic fern by the nest and put them inside. At one stage male took a bit from her and held it till she was ready to place it. 12.59 . . . Female dropped fern, refused pellets offered by male, and flew away.”

The fact that on this occasion the female appeared to swallow a lump of soil brought by the male, in conjunction with the regularity with which dry soil was brought to the Ngua nest in 1935, makes it probable that to a certain extent the female is capable of elaborating plaster for herself. On the whole, however, the tempo of building is set by the male, and an exceedingly variable tempo we have found it. Except on the single occasion quoted in the last paragraph, there is no record of her ever refusing material offered by the male, and although she often kept him waiting in the middle of a pellet sequence it always appeared to be because she was busy. She evidently worked with great care; for example when on 6/11/34 she kept him waiting from 10.33 till 10.53 Venables noted that whenever she was visible she seemed to be working. Generally the male's absences varied between a quarter and half an hour, but he often brought very little when he did come. Thus between 09.24 and 13.12 on 6/11/34 Venables saw only 69 pellets given as a result of six visits.

The birds made appreciable progress with their building after that date but there were long spells of indolence. On 19/11, the last day in the 1934 season when the pair spent any long period at the nest, they were there for two hours without doing anything at all towards completing the plaster. As showing the nature of the interest both birds still took in the hole, extracts from Venables' notes may be reproduced :—

- " 09.14 Pair arrive hole calling loudly. Both frequently look in and sometimes 'kiss.'
- " 09.19 Female climbs up nearby liana but male continues to look into hole.
- " 09.20 Male also climbs up liana; does not touch female, but she flies away. . . .
- " 10.04 Pair arrive—male to hole, female to nearby tree. . . .
- " 10.10 Both to hole. Female clings to entrance, male on usual place [the overhanging boss]. Both often gaze in.
- " 10.14 Female joins male and sits with back to hole. He continues frequently to look in.
- " 10.26 Male leaves. She turns round and sometimes looks in.
- " 10.38 He returns. They nibble each other's bills and look into hole. Later 'just sit' [on the boss].
- " 11.02 After further peering alternately female enters.
- " 11.08 Male looks in, turns tail, and leaves.
- " 11.11 She comes out and sits on boss.
- " 11.27 She flies off."

" PERSONAL RELATIONS " BETWEEN THE PAIR DURING BUILDING.

In popular accounts of hornbill nesting—derived from I know not what source—it is usually implied that the male exercises some compulsion.

In our experience of *Bycanistes cristatus* so far from the male's driving the female into the nest he repeatedly arrived there alone. If, as sometimes happened, when she did arrive she merely flew off again without entering, the male followed her with no signs of resentment.

Only twice was he seen to urge or assist her into the hole in any way. At 10.16 on 6/11/34, in an early stage of building, when the pair had "wasted" an hour at the still wide-open hole without doing any work and she was sitting on the rim with her rump and tail out, he "touched (perhaps nipped) her rump with his beak and she went in" (Venables). "In a few moments her head appeared in the hole and she sat with it outside. He leaned down from his boss, but before his beak touched hers she withdrew, only to re-appear as soon as he sat up." At 10.20 she withdrew her head and began to work inside.

At 11.15 on 27/11/35, by which date the female was having great difficulty in forcing her way in and out, Mrs. Moreau noted:—

"Both arrive. She tries to get in. Unable. She looks up at male [on the usual boss]. He places his bill behind her neck and gently pushes her head into the hole. She tries again unsuccessfully and again lifts her head towards male. He ignores her and she tries again, putting one wing forward. She is almost in when male pushes her vent with his casque and at 11.25 she is in."

No "display" was ever seen; there was much evidence of what may be called affection but little of passion. They frequently nibbled each other's bills and the male was seen to bend down and caress the female's neck on one of the rare occasions when she worked from outside the hole. Copulation was observed once each season about ten days before work ceased, both times when the female emerged after a morning's work. Venables recorded the occurrence on 6/11/34 as follows:—

"Both are side by side on a branch [just above the hole]. He jumps once on and off her back like a House Sparrow. Then on immediately afterwards and mates. Both birds have wings folded to side and male balances by tail only. No display and both silent. Coition takes about eight seconds."

During the building we all gained the impression that the hornbills' actions were more deliberate and less mechanical than those of

many small birds when nesting. Quite apart from their affectionate passages they seemed to be aware of each other personally to an unusual degree. Our impression doubtless owes much to the constant close interest the male showed in the female at work, bending down and peering into the hole at her. But several incidents, slight in themselves, were noted that seem to indicate an unusual relationship between the birds :—

1. In the male's absence the female had come out of the hole about 13.30 after a four-hour spell of work, evidently ready, as usual by then, to depart until the following morning. When, however, he appeared just afterwards, she evidently realised he had pellets; she clambered in again, a thing most unusual at the end of the day's work, accepted them and placed them before flying off with him.

2. As just related, after she had twice failed to get into the hole the male helped her, apparently at her request.

3. He had arrived first and, contrary to his custom, was examining the hole from its lower side. When she came in sight he apparently realised he would be in her way, and he moved, before she alighted, to give her clear ingress.

4. While he sat on the boss above the hole, she, outside, hacked off a lump of fern base. This she gave him to hold for a few moments until she had done a little work inside, apparently preparing a place for it.

5. When the Ngua female made her final entrance in 1935 the male showed great excitement. This was not observed with other entrances of either female, however difficult.

THE PERIOD OF NEST OCCUPATION.

Throughout the period of approximately four months during which the female did not leave the nest, the male made a number of visits each day and practically never failed to bring fruit with him. Except that he sometimes carried a large-sized fruit in the tip of his mandibles the fruits were carried in his gullet and disgorged in exactly the same manner as the pellets.

At the Ngua nest it was usually possible to see the size and colour of the fruits the male brought. Occasionally he let one fall which we were able to collect by searching at the foot of the tree. These dropped fruits never showed any signs of digestion even when the male had been carrying them inside him for so long as 35 minutes; and with the help of these specimens we were eventually able to make sight identifications of many of the fruits brought by the male as he passed them in. Year after year the bulk of the fruit brought consisted of stone-fruits the

size of small cherries, *Sersalisia usambarensis* up to about the end of December and thereafter "mbambe."* But these staples were supplemented with a variety of larger fruits among which Greenway identified *Canthium* sp., *Passiflora edulis* (the introduced passion fruit), *Ficus* sp. (fig), *Odyndea Zimmermannii*, and *Heterophylla* sp.

Owing to the narrowness of the slit we could never observe the actions of the birds inside the nest hole. When the male was offering food or bark at the slit it was always taken immediately, and when he had actually alighted at the hole piping and grunting, presumably of the young and the female respectively, could sometimes be heard. Once I observed that as the male passed a large fruit through the slit the grunting was momentarily strangled. The male himself spent some time each day on the upper branches of the next tree but was always silent. It was remarkable that as observed in every season, the birds inside the nest made no sound except when he was actually at the hole; thus his visits could not have been stimulated by manifestations made by his family.

The birds inside did not push their heads nor even their bills out. Except when the male was at the hole the only sign of occupation was that at intervals some small object which glinted in the sun would come hurtling out and fall to the ground. I conclude that they were fruit-stones, for among the dejecta at the foot of the tree I found "mbambe" stones that were perfectly cleaned but still moist. Almost certainly they were "casts." At my request the authorities at the London Zoological Gardens have kindly tested the hornbills there and I am indebted to Mr. C. R. Stonor for information that they "cast" the stones of fruit they have eaten.

The question now arises of the sanitation of the nest. The excrement of two large birds over a period of nearly four months would, one supposes, have to be got rid of in some way. The male took nothing away from the nest hole. On the ground underneath it, where there was a slight smell of guano, I found four kinds of dejecta:

1. By far the greater part consisted of cleaned fruit-stones, presumably "casts," numbering probably some thousands.
2. One or two "mbambe" stones associated with partially digested skins.
3. A little pale brown faeces.
4. One or two splashes of whitish faeces associated with millipede rings.

Dr. Worsley analysed these: (2) and (4) apparently contained some uric acid, but (3) none.

* "Mbambe" = *Polyalthia oliveri*, Bak. (ANONACEAE).

An excellent series of feeding observations was obtained during the 1935/36 season at the Ngua nest by utilising African observers who watched on two days a week from dawn to dusk. Table 1 summarises their field notes. I was occasionally able to check the records of observer S(imon) by independent watching. Observer I(di) was employed when I was away and Simon could not be spared. It will be noticed that on two days remarkably high figures were recorded by Idi. I can only say that there was nothing suspect in the detail of his field-notes, and when I cross-questioned him I could not shake him. Moreover on 18/3/33 I myself saw 77 fruits (62 "mbambe" and 15 of the large *Canthium* sp.) given in four visits between 08.40 and 09.54, i.e. in 74 minutes. If this rate were maintained through the ten-hour working day it would give a total considerably exceeding that recorded by Idi.

| Date. | Watcher. | Time of male's first visit. | Time of male's last visit. | No. of visits by male. | Longest interval between visits. | Shortest interval between visits. | Total number of fruits brought. | Greatest number of fruits at a visit. | Average no. of fruits at a visit. | No. of pieces of bark brought. |
|----------|----------|-----------------------------|----------------------------|------------------------|----------------------------------|-----------------------------------|---------------------------------|---------------------------------------|-----------------------------------|--------------------------------|
| | | | | | mins. | mins. | | | | |
| 19/11/35 | S. | 06.40 | 17.05 | 10 | 127 | 10 | 115 | 31 | 11 | 2 |
| 22/11/35 | S. | 09.00 | 16.34 | 12 | 95 | 16 | 111 | 19 | 9 | — |
| 25/11/35 | S. | 07.02 | 16.34 | 11 | 110 | 13 | 102 | 21 | 9 | 3 |
| 28/11/35 | S. | 07.25 | 15.35 | 13 | 85 | 11 | 79 | 9 | 6 | 1 |
| 1/12/35 | S. | 08.09 | 16.03 | 14 | 132 | 12 | 89 | 10 | 6 | — |
| 8/12/35 | S. | 07.45 | 16.28 | 11 | 99 | 26 | 104 | 20 | 9 | — |
| 11/12/35 | S. | 07.40 | 16.04 | 11 | 119 | 9 | 123 | 25 | 11 | — |
| 15/12/35 | S. | 07.15 | 16.08 | 11 | 92 | 19 | 143 | 27 | 13 | — |
| 22/12/35 | S. | 08.05 | 16.45 | 11 | 91 | 25 | 154 | 30 | 14 | — |
| 25/12/35 | S. | 07.55 | 17.16 | 12 | 81 | 16 | 156 | 25 | 13 | — |
| 29/12/35 | I | 07.10 | 17.10 | 15 | 110 | 14 | 231 | 39 | 15 | 3 |
| 2/ 1/36 | S. | 07.10 | 17.18 | 14 | 90 | 18 | 237 | 29 | 17 | 1 |
| 5/ 1/36 | I. | 07.15 | 17.39 | 16 | 73 | 13 | 209 | 30 | 13 | 4 |
| 9/ 1/36 | I. | 07.08 | 17.12 | 17 | 80 | 6 | 228 | 28 | 13 | 5 |
| 12/ 1/36 | I. | 07.11 | 17.49 | 16 | 71 | 20 | 248 | 32 | 15 | 5 |
| 16/ 1/36 | I. | 07.18 | 17.45 | 21 | 72 | 9 | 342 | 35 | 19 | 8 |
| 19/ 1/36 | I. | 07.02 | 17.05 | 19 | 56 | 11 | 262 | 35 | 14 | 6 |
| 23/ 1/36 | I. | 07.20 | 17.52 | 24 | 59 | 11 | 569 | 45 | 24 | 1 |
| 26/ 1/36 | I. | 07.12 | 17.09 | 22 | 57 | 8 | 504 | 42 | 23 | 2 |
| 30/ 1/36 | S. | 07.23 | 17.41 | 20 | 78 | 11 | 300 | 28 | 15 | 4 |
| 2/ 2/36 | S. | 07.27 | 17.52 | 17 | 89 | 15 | 313 | 29 | 18 | 5 |
| 6/ 2/36 | S. | 07.18 | 17.43 | 18 | 80 | 12 | 336 | 33 | 19 | 5 |
| 9/ 2/36 | S. | 07.19 | 17.49 | 19 | 84 | 11 | 341 | 30 | 18 | 5 |
| 13/ 2/36 | S. | 07.09 | 17.58 | 18 | 110 | 7 | 332 | 31 | 18 | — |
| 16/ 2/36 | S. | 07.14 | 17.53 | 16 | 76 | 17 | 279 | 27 | 17 | 1 |
| 19/ 2/36 | S. | 07.06 | 17.51 | 17 | 81 | 9 | 270 | 23 | 16 | — |

Whether or not we accept the exact numbers recorded by Idi certain facts emerge clearly from Table 1. Until the end of December, when the female had been in about seven weeks, the daily number of the male's visits remained very constant. They averaged 12, and varied only between 10 and 14. Thereafter the number increased steadily to an average of 21 during the latter half of January (maximum 24 on 23/1), followed by a slight but definite decline. During the last three weeks before the birds came out of the hole the male's visits varied from 16 to 19 a day.

Since a variety of different fruits was brought to the nest a comparison of the daily totals of fruits lacks equal exactitude and force; but it is true that throughout the period fruits of small-cherry size formed the bulk, and it is at once apparent from the table that the daily totals of fruits followed a similar curve to that of the daily number of visits. The smallest rations are at the beginning, from 79 to 115 fruits, with an average of 100 for the first five weeks the female was in. Then, nearly three weeks before the daily number of visits rose, a slight progressive increase began in the daily total of fruits. By the tenth week the average number had risen to over 300, where it remained until the week before the birds left the hole.

"Mbambe" fruits were at that time the staple food. I ascertained that they averaged 2.2 gm. in weight including their 1.0 gm. stone. Thus, towards the end of the fledging period the female and (one) young received quite 360 gm. (11 ozs.) of edible material and probably more, since there were some bigger fruits included in the daily total of 300 odd. This compares with a "live weight" of about 1,200 gm. for the two birds combined.

The intervals between the male's visits were variable at all times; there was always at least one interval of from one to $2\frac{1}{4}$ hours during the day when he did not come, but his shortest interval in any one day never exceeded 25 minutes and was sometimes as short as 8.

The table gives a total of 6,176 fruits brought to the nest in 26 full working days. Therefore during the whole period of the female's residence in the hole the male must have passed in about 24,000 fruits, and it appears also that he must have made 1,600 visits with food.

One element in the male's behaviour during this period is at present quite unexplained, namely that he often passed in a piece of bark before beginning to disgorge a cargo of fruits. According to the records he brought bark irregularly during the first eight weeks, and never more than three times a day; but from 5/1 to 9/11 the average was nearly 5, much greater than recorded during the building process.

The male seemed to select the bark with some care, and he often played with it, tossing it about and chewing it for as much as 15 minutes. To pass the bark through the hole he had to get it held

vertically by its edges in his mandibles, and in his endeavour to do that he often broke the bark or dropped it. Thus, during a short spell of watching on 1/1/35 I noted:—

- “ 10.15 Male gave bark and 29 ‘mbambe.’
- “ 10.53 Arrived next tree, tore off lump of bark, carried it to high branch of next tree, played with it and dropped it. At once went to hole and gave seven ‘mbambe.’
- “ 11.06 Landed on (living) Polyscias tree and chipped at epiphytic mass. Passed to nearby dead tree and detached large curled lump which he brought to upper branches of nest tree. He played with it, tossing and chewing it, until it was all broken up. Then picked bark off nest tree and took it straight to hole. Followed by disgorging four large fruits.”

If the table be examined a modification in the male's habits is discernible about seven weeks after the female's entrance. Up till then the time of his first visit in the morning varied between 06.40 and 09.00; for the last eight weeks he was remarkably punctual, always between 07.02 and 07.27. About the same date he also began to work longer in the afternoon, making his last visit between 17.10 and 17.58, whereas previously he had often given the female her last feed before 16.15. In effect the male increased his working day from eight to ten hours.

It will be seen from the table that this change took place between 22 and 29/12/35, and that a marked rise in the daily number of visits and fruits took place between 25 and 29/12. (The supply of bark increased sharply a few days later.) These facts point to a probability that the young bird was hatched about 25/12, but the period of 50 days that elapsed after the female entered seems unreasonably long; the observations collated elsewhere (Moreau in press) tend, however, to explain this in that they show delay and irregularity in laying to be characteristic of hornbills in general.

I commented above on the slight decline in the number of visits the male made in the last few days before his family emerged. Certainly the decrease in the number of fruits he brought on 16/2 and 19/2 looks significant. If now reference be made to the account of the female's exit on 21/2 it will be seen that on that morning the male made his first two visits without bringing any food, although he produced fruits when his mate had begun to break her way out. These observations are important because we have no other record of the male's coming to the tree in the morning without bringing food to the nest. On the whole the points mentioned in this paragraph combine to indicate a slackening in the male's attentiveness and perhaps an

awareness that his family were due to come out and provide for themselves. But previous to that the male had increased the amount of fruit he brought to meet the growing needs of his family, although they did not give him the vocal stimulus often considered important in ensuring adequate attention on the part of parent birds in general.

On the interesting question of the female's condition in the nest, and especially whether she moults so suddenly and completely as to be incapable of flight, like some *Lophoceros* females, we necessarily learnt nothing. It is, however, worth noting that female *B. cristatus* are to be seen on the wing all the year round, and one collected shortly after the nesting season of the species was moulting gradually though irregularly. The possibility that broodiness alters the whole physiology of the moult of course remains.

BREEDING BIOLOGY IN RELATION TO THE MAINTENANCE OF THE POPULATION.

There is no evidence that the clutch of *Bycanistes cristatus* ever exceeds two, the number ascribed to it by native informants (cf. also Mouritz, 1914). Since the breeding season is so well defined and a clutch with the accessory repair of the nest occupies the birds for at least four months, it is certain that only one brood a year can be reared.

The biotic potential thus indicated is low; but even so it appears to me that in Usambara it cannot be either external biological controls—still less climatic—that play the chief part in maintaining the stability of the *Bycanistes* population. The hornbills are large, with powerful bills and feet, and they are removed beyond the range of several predators by the fact that they rarely leave the tops of tall trees except when building, and then only the males. The only creatures that can be conjectured as a source of mortality to adult *Bycanistes* are the accipitrine birds *Stephanoaëtus coronatus*, *Gypohierax angolensis*, and, more doubtfully, *Circaëtus fasciolatus*. Perhaps by night the great *Bubo lacteus* may raid a roost. We have seen a male hornbill stop work and “freeze” when a *Gypohierax* landed on the nest tree, but the small eagle *Aquila wahlbergi* was repeatedly chased away. Drongos often mob these hornbills. A pair of the forest species, *Dicrurus l. ludwigii*, constantly worried the Amani male while he was bringing material to the nest, but I do not think they seriously interfered with his activity.

Mortality in the nest-hole from predators is probably ruled out by the powerful combination of protective factors: the position of the holes favoured, the strength of the mud wall, the narrowness of the slit left in it, and not least the uninterrupted presence of the mother bird there with her great beak. In any case, the only nest raider of potential importance in Usambara is the “Blue Monkey,” though the several squirrels, including the flying species, *Anomalurus orientalis*,

and locally the Harrier-hawk, *Gymnogenys typicus*, might perhaps have to be reckoned with.

Neither old birds nor young just out of the nest have yielded an appreciable number of ectoparasites, so that I doubt the importance of these as a control.

The really effective control is that a large proportion of the birds do not breed every year. This is proved by the fact that roosting concentrations with no obvious change in the proportion of females are to be seen all through the year, and never more obviously than during the breeding season. Three causes probably contribute to this effect.

1. The very large holes required must be limited in number, especially those of suitable form, even in a forest like that of Amani. And such holes are always liable to be occupied by bees. Moreover, it seems likely that an otherwise desirable hole may temporarily "wear out." Since the Ngua tree was killed by fire in 1932 the male has worn away the bark at his particular perching spot so that it is difficult for him to get the necessary grip where he wants to. This is quite intelligible when it is remembered that in every season he clings just below the hole for several minutes on 1,600 occasions with food and on others besides with material. The sketch in Plate I was done in 1933, when he could perch so that his head was comfortably on a level with the top of the slit. By 1936 he could only get a grip with his feet lower down and he had to stretch his neck to reach the slit at all. He will probably get his position back when the substance of the tree has rotted or cracked enough to give a new grip.

2. The young may not be sexually mature until they are some years old. van Someren (1922) has given reason to suppose that this is the fact with the Ground Hornbill, *Bucorvus cafer*. It appears, however, that in *Bycanistes cristatus* the parents and young cease to form a family unit soon after the latter fly and do not stay together for years as van Someren records of the Ground Hornbill. The young *Bycanistes cristatus* are to be found at the communal feeding and roosting places practically as soon as they fly, and there is a tendency for young birds to keep together. We once saw nine of full size but with the bills of immatures, engaged in horse-play, shoving each other about on the branch of a tree and wrestling with their bills.

3. It is clear from the history of our nests that what may be called internal causes operate powerfully to reduce the rate of reproduction. Of six attempts at breeding that we have had under observation three came to nothing after the birds had spent several weeks on the preliminary stages. In two consecutive years at the Amani nest, they appeared to exhaust the breeding impulse in

the effort of building and to this result defective salivation in the male might have contributed. In the Ngua nest the female broke her way out shortly after entering, perhaps owing to failure of impregnation.

I conclude that in the control of the *Bycanistes* population internal factors are the most important.

LOPHOCEROS DECKENI.

This hornbill is confined to semi-arid East Africa from Somaliland through Eastern Kenya to just south of the Tanganyika border. Nothing of its biology appears to be on record except for the few notes by Moreau and Moreau (in press). The bird appears to belong to dry *Acacia-Commiphora* bush up to about 4,500 feet. Its food consists mainly of invertebrate animals, and it also eats buds and berries.

THE LONGIDO NEST: 1932-1936.

All the observations that follow were made at Longido, north of Kilimanjaro, by Mr. S. A. Child, except for a few I was able to make at the same nest in January, 1936. The hole was about 12 ft. from the ground in the trunk of a big acacia tree, and its entrance was hardly more than 2 ins. in diameter, impossibly small one would think for the passage of a bird the size of this hornbill.

In 1932 it was frequented by a pair of starlings, *Spreo hildebrandtii* which probably laid eggs there. A pair of Van der Decken's hornbills paid occasional visits which were fiercely resented by the starlings. In January, 1933, the hornbills took possession, clearing out the hole and apparently enlarging its interior. The female did most of the work from outside.

The date she entered that season is unknown, but she emerged on 7/4/33. The hole was re-sealed, leaving a vertical slit no more than $\frac{3}{16}$ of an inch wide. Both parents brought food to the young until they flew on 30/4. The young themselves began to pick away the plaster on 28/4 and the old birds appeared to give them no assistance. Thus the young remained by themselves for 23 days after the mother had left them.

In February, 1934, the hornbills were mating again. Unfortunately Child was away on duty for most of March; but when he returned on 28/3 the hole was closed and there is reason to believe that the female made her entrance between 12 and 20/3. She emerged on 27/4 and the hole was re-sealed at once. Judging by what little he could see through the slit, Child thought that the young might then be about three weeks old. They squalled and pecked energetically at the

slit if he touched it. Both parents brought food till 24/5, when the young pecked their way out.

In the 1935 season Child learnt the complete story, recorded as follows :—

25 and 26/2. Pair at hole.

27/2. 09.00. The hole which was completely open the preceding afternoon is now sealed.

29/3, 17.00. Child removed two-thirds of the plaster. Female at once began re-sealing with fibres torn off the inside of the nest hole. No material from outside was used. While she was working she could be heard tapping like a woodpecker.

30/3, 12.00. Hole completely re-sealed.

17.00. Child broke away a piece of the new plaster. He also bored a hole in the tree-trunk about six inches below the slit and with the aid of an electric torch saw two eggs in the nest cavity, one of them chipped and squeaking. He re-plugged his observation hole.

17.10. Female began re-sealing again, using the side of her bill to press the material into place and tapping quickly.

2/4. Nest contained one egg and one perfectly naked young bird, which in the light of a torch looked creamy white.

4/4. Second egg hatched.

10/4. Both young still practically naked.

24/4. 09.00. Female seen out for the first time. Her plumage very fresh. Hole already re-sealed.

25/4. 15.00 Child removed sealing and saw young were partially feathered.

16.00. Hole already partly re-sealed from inside. One young bird, obviously bigger than the other, seemed to be doing most of the work, using exactly the same methods and material as the mother had when she sealed originally. The young birds' bills were already quite hard and they bit vigorously when Child poked a finger into the hole.

The bills of the two young were already coloured differently. One, presumably the female, had the whole bill dark with a few paler flecks. The other showed the same pattern as the adult male, but what would become the red part was paler than the future white part.

26/4. Child removed some of the plaster and it was repaired in a few hours, just as it had been a few days before.

14/5. The young began to peck away the plaster.

15/5. 08.30. Only the female young bird was left in the hole. The young male had gone right away.

16/5. Young bird in the hole kept putting her head out, peering up and down and pecking at the sides of the hole.

17/5. Child wished to photograph the young bird as it came out and tied a string across the hole until he was ready.

18/5. He removed the string but the young bird stayed in. Afterwards he re-strung it.

19/5. He found the string pulled away and the young bird gone.

From late November, 1935, onwards a pair of *Lophoceros deckeni* again frequented the tree, courting and copulating. They put their heads into the hole frequently but were not seen to enter until 3/1/36, when the female sealed herself in again.

When I examined the hole with Child on 15/1/36, we found that the twigs with which he had blocked his observation hole in the previous season had been removed. In their stead bits of bark, on which the two white eggs were lying, had been piled in from the inside. The nest gave out a sour smell, but from the strip of white dung at the foot of the tree it was evident that the bird voided outwards through the slit. She was capable of much expelling power, for the dung extended up to three feet away. On analysis Dr. Worsley found this dung to contain plenty of both urea and other nitrogenous matter.

At 09.15 on 15/1 I chipped away the whole of the walling, the bird inside remaining perfectly quiet while I did so. The plaster was dark grey, sour smelling, and very hard. Under the microscope it could be seen to contain much fibrous material, mixed with fragments of insects. Worsley's analysis showed that it might contain some dung.

By 08.00 on 16/1 little had been done towards re-sealing. Eight hours later good progress had been made. During the greater part of this period I had the nest under observation, and I saw the male visit it frequently. On each occasion he held a single small morsel, apparently an insect, in the tip of his mandibles. He passed this through the slit and always flew away at once without disgorging anything. Once only he brought a scrap of bark which I saw him break off the nest tree. I conclude that the male brought practically no material specially to assist the female to rebuild the plaster I had removed, and that she elaborated it all for herself out of the remains of food and rubbish (chiefly rotten wood) available in the hole.

Between 09.30 and 12.30 the male fed the female 17 times with, among other things, a large grasshopper, a fat white larva (twice), and a very large mantis. He always came gliding up to the hole swiftly and silently, clung to the bark for a matter of seconds only, and departed again as he had come. It is remarkable that when he made

his first visit with food 15 minutes after I had removed the plaster he showed no surprise at finding the hole open, but settled and fed the female without hesitation.

Child's observations in the four seasons may be summarised in the following table. It is unfortunate that his transfer from Longido leaves the history of the 1936 nesting uncompleted.

TABLE II

| Year. | Date female entered. | Date young hatched. | Date female came out. | Date young flew. |
|-------|----------------------|---------------------|-----------------------|------------------|
| 1933 | ... ? | ... ? | ... 7/4 | ... 30/4 |
| 1934 | ... 15/3 \pm 13 | ... ? | ... 27/4 | ... 24/5 |
| 1935 | ... 27/2 | ... (31/3), 4/4 | ... 24/4 | ... 15/5, 18/5 |
| 1936 | ... 3/1 | ... ? | ... ? | ... ? |

DISCUSSION OF THE OBSERVATIONS.

The first young bird was hatched 33 days after the female entered but it is not known what delay, if any, took place before she laid. Almost certainly there was an interval of several days between the two eggs, because one was hatched four days after the other, a difference that persisted to their fledging.

The female left the young after being nearly eight weeks in the nest, when they were only 21 and 25 days old, but they were capable of replacing the broken plaster at once, and apparently of elaborating its substance themselves. After the female's departure the young remained in the nest for periods varying from 22 to 28 days in successive years.

The dates the female entered in the four years show that there is a definite breeding season at Longido, with an annual variation of about 10 weeks. This variation might be expected from the irregularity of the most important element in the local climate, which is the rainfall; but the connection of the breeding date with rain is far from obvious. There was a great deficiency of rain in both 1933 and 1934, associated with complete failure of the "long rains" of March to May, when most of the annual total is expected. But the persistent drought by no means inhibited the breeding of these hornbills, as, according to Child's information, it did for most of the local birds. But in 1936, following the unusually generous rain of December, 1935, the female entered on 3/1, much earlier than in preceding years.

In 1933-1935 the fledging of the young fell within the period when the "long rains" were to be expected. At first sight then the initiation of breeding in this hornbill is timed to secure optimum food conditions; but until we know something of the phenology of the invertebrates on which the birds feed it would be wrong to jump to this

conclusion. It is worthy of note that although the expectation of "long rains" was not fulfilled in either 1933 or 1934 the young were reared. And in 1936 the female entered so early that nearly all the food would have to be supplied to the nest before the "long rains" would normally be expected.

LOPHOCEROS MELANOLEUCOS.

This hornbill is more wide-spread both geographically and ecologically than either of the species dealt with above. It is mainly a bird of long-grass short-tree savannah throughout South and East Africa, but it also recurs in semi-arid thorn-bush and in the edges of evergreen forest, up to at least 7,000 feet. It has a wide range of diet, small vertebrates as well as invertebrates and fruit. Nestling birds are eaten, and we have seen these hornbills buffeting a nest of *Ploceus bicolor kersteni* in an attempt to knock the young ones out. Reichenow (1900), Stark and Sclater (1903), and Cowles (1926) have published useful notes on this species.

On 22/1/36 Mrs. Moreau found an occupied nest 25 feet up in a *Piptadenia* trunk in fringing forest at the foot of Kilimanjaro. A natural hole about five inches by four had been blocked with grey plaster to leave a slit about $\frac{1}{2}$ inch wide. The young birds raised their whickering hunger cry whenever a fair-sized bird passed their side of the tree, whether it was a hornbill or not. The usual fan of whitish dung extended for a few feet away from the foot of the tree.

When we watched the nest it at once became apparent that both the male and the female were bringing food to the young. Instead of clinging to the trunk they regularly used a small branch which hung down at a steep angle within reach of the hole. On 23/1 in the 3 hours 20 minutes between 08.40 and 12.00 they made 18 visits, on 14 of which they passed food (always a single morsel brought in the tip of the mandibles) into the nest. Fruit and grasshoppers were occasionally distinguishable. At one visit on 22/1 a small bird was brought to the nest, apparently a Paradise Fly-catcher (*Tchitrea viridis*) about ready to fly. The hornbill kept on chewing it to reduce its bulk, but always failed to get it through the slit, and finally flew away with it. On two occasions on 23/1 the old birds brought bark to the nest. The second time, after repeated attempts to get the bark into the slit, the hornbill let it drop, caught it again cleverly before it reached the ground, and flew away with it.

L. melanoleucos breeds about the beginning of each year in the garden of Col. the Hon. M. T. Boscawen at Moa (on the coast about 70 miles south of Mombasa). He informed me that in 1936 their usual hole had been occupied by bees and they took over another about 5 inches in diameter, which they plastered to leave a slit 3 inches by $\frac{3}{4}$. On 14/2/36, when the female had been in about a fortnight, he removed

some of the plaster for me and also sent some of the dung, which the female squirted to a distance of several feet out of the hole. As with *L. deckeni* she made no disturbance when the plaster was removed and no attempt to come out. Col. Boscawen tells me that he could see her working to repair the plaster, which was complete again in about four days.

The plaster strongly resembled that of *L. deckeni*, hard fibrous material mixed with fragments of insects, but it was less well compacted and coarser in grain. Dr. Worsley found that it gave only a faint reaction for nitrogen, whereas in the bird's dung the indication for nitrogen was very strong. This made it practically certain that the bird's own dung was not an important constituent of the plaster.

Later Boscawen wrote :—

" The female left the nest 13/4. There seemed to be three young all well grown. Both male and female fed them with large insects, chiefly large mantis, but I also saw cicadas and caterpillars being taken.

" For the first two or three days after female left no apparent attempt made to repair plaster. The young then began to rebuild from inside and by 20/4 the hole was much the same as when the mother was inside.

" 25/4. Plaster again broken and I noticed young looking out of the nest.

" 27/4. Early morning all young had flown."

These observations show that the female was in the nest 60-73 days, probably nearer the latter, and that the young flew about 14 days after she had emerged.

SUMMARY.

Bycanistes cristatus breeding activity in Usambara starts about the end of October with a regularity difficult to explain in view of the equable evergreen conditions.

In one nest probably three broods were reared in four years. In the remaining year the female burst out and flew away about three weeks after the hole had been closed.

At a second nest the pair worked for a month in 1934 and a fortnight in 1935; but although at the end the nest seemed ready they never occupied it.

Practically all the material for closing the nest was brought by the male and the placing of it was done by the female working from inside. Hours of work were only from about 10.00 till 14.00. At the end of them the female came out so long as she could squeeze through the constricted entrance.

The material consisted mainly of pellets elaborated in the gullet of the male from dry earth and disgorged in series up to 42 at a visit. The biggest day's work was 235 pellets in 15 visits. The plaster set hard, apparently with the aid of the male's saliva as cohesive agent and with scraps of bark as binders.

Since a day's work involves the impregnation of about 33 cu. ins. of dry soil with saliva by the male, no small demand is made upon his secretions. There is some evidence that they are abnormal at this season. Inadequacy of his saliva may well account for failure to complete plastering.

The female was not in any way compelled by the male to shut herself in. The pair gave evidence of much mutual affection and understanding but little passion.

A female remained in the nest for 108 days, emerging with her (single) young. Both were able to fly at once.

During this period the male made about 1,600 visits with food and brought about 24,000 fruits. At first he averaged 12 visits and 100 fruits in an eight hour working day, but after the female had been in about seven weeks these were all increased. Probably the change marked the hatching of the egg.

When the young was nearly fledged and the weight of the two birds inside the hole was about 1,200 gm. at least 360 gm. of edible material was being given them each day.

Besides food the male brought bark throughout the fledging period. Its use is unknown.

Biological control of the *B. cristatus* population is probably of little effect. The biotic potential of the species is, however, low, and a large proportion of them do not breed in any given year for reasons that are indicated.

Lophoceros deckeni.

The female elaborated her own plaster out of insect casts and rotten wood from the inside of the hole. No special material was brought by the male. When the plaster was removed she made no attempt to come out and repaired the damage in a few hours.

The female came out about 8 weeks after her entrance, the young being then 21-25 days old. They at once replaced the plaster themselves without external aid. They flew after periods of 22-28 days during which both parents fed them.

These hornbills always brought food in single morsels held in the mandibles, and did not disgorge.

The phenology is discussed.

Lophoceros melanoleucos.

Both parents were seen bringing food—insects and a young bird—to a closed hole in which young were calling.

Plaster used to seal the hole on the entrance of a female consisted of fibres and insect casts, without dung.

A female remained in the nest for about 70 days. On her departure the young themselves replaced the plaster and remained in the hole for another 14 days.

I would wish to draw special attention to the precocity of the young. Such technology as displayed by this species and *L. deckeni*, the latter when only 25 days old, is probably without parallel in the world of birds.

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THE BIRDS OF KENYA AND UGANDA.

VOL. II. PART 5.

By V. G. L. VAN SOMEREN, M.B.O.U., C.F.A.O.U., F.L.S., etc.

CHARADRIIDAE. Continued.

Genus *ARENARIA*.

ARENARIA INTERPRES INTERPRES, Linn. TURNSTONE.

Ref. : Linnaeus, Syst. Nat., 1758.

Type locality : Gothland.

DISTRIBUTION :

A winter migrant to the coast of Kenya, from northern Europe and Siberia.

DESCRIPTION : (Plate 4.)

Adult, winter : Forehead, lores, crown to nape ashy-brown, paler on the forehead, centres of feathers black ; a blackish patch at the anterior angle of the eye ; cheeks whitish with buffy tinge ; a blackish streak at angle of mouth ; earcoverts ashy-brown streaked with blackish ; chin and throat white. Mantle and scapulars black-brown, with ashy-brown to buffy edges, often worn to whitish ; scapulars with tawny outer edges. Back and rump white, with a blackish V at the upper part of the upper tail-coverts, remainder white. Tail, sepia black on exposed area, with white bases and white tips, the dark area in the form of a bar which is reduced in width from mid-outward so that the outermost feather is almost entirely white. Wing-coverts : lesser ones blackish brown, paler at edges ; median coverts sepia black with paler edges and dark centres ; primary coverts black-brown with inner ones tipped white ; greater coverts black-brown with wide white tips and whitish on inner webs.

Primaries brownish-black with narrow white edging, white shafts, and white on the inner webs, the white extending on to the outer webs in the case of the inner primaries ; secondaries sepia-brown with white bases and white tips, the inner ones almost or entirely white, long innermost feathers sepia with pale edges and dark central streak. Breast with two large sepia to black-brown patches with a whitish patch toward centre, the dark colour crossing the upper breast but leaving an inverted V area of white which continues down over the lower breast, abdomen and sides.

Bill black at end and sepia at base; legs and toes ochreous to tawny. Eyes brown.

Males and females very similar in colour in winter dress. Toward the end of their stay, the adults assume breeding dress, but the complete summer plumage is not completed before departure. The change in plumage takes place in January to March, and is almost complete, the primaries and most of the secondaries being retained.

An adult male is figured. The forehead and lores are white, the white extending over the eye and contiguous with a white patch over the ear-coverts; a narrow black streak crosses the forehead from eye to eye; there is a black patch below the eye which reaches the black gula streak. The crown is sepia with dark centres. The black gape streak extends back as a nape band, setting off the white bar on the lower neck; chin and throat white, followed by a black breast patch, the two patches meeting across the upper breast and forming a white triangle, the white of which extended to the whole of the underside. The mantle is glossy green-black and reddish-russet, many of the feathers pale-tipped but these tips wear off rapidly; scapulars of the same colour as also the long innermost secondaries; the lesser and median coverts are blackish with russet-red edges and tips. The adult female is somewhat like the male, but the light areas of the head are tinged with buffy and the dark areas are more brownish; the russet of the mantle and scapulars and long inner secondaries is not so reddish; the wing-coverts only slightly tinged with russet. Wings 138-148 mm.

The bill is black; legs and toes dark orange; eyes brown.

As the birds do not breed here, we need not deal with the eggs or young in down.

Immature, first winter : These resemble the adult in winter plumage i. many respects, but the general tone of plumage is duller black-brown, and the pale tips and edges to the mantle, scapulars, coverts and tail are sandy to buffy. The breast patch is more sepia and mottled white, the dark tips hardly obscuring the white bases to the feathers.

HABITS :

As already stated, these birds are visitors from Northern Europe and Asia, arriving in large flocks in September and being very numerous in October. They remain along the coast up to the end of March or beginning of April. The Turnstone has been reported from Lake Victoria, but more evidence is required. It is essentially a bird of the maritime littoral, and the estuaries of the larger rivers, such as the Tana and Juba.

They are always in flocks, varying from half a dozen to hundreds. When feeding they are restless in their movements, darting hither and

thither after crustacea. They usually feed along the tide line. The food consists of crustacea and small mollusca, larvae of various kinds, very small fish-fry, and a certain amount of seaweed. In flight they are conspicuous; the actual flight is rather slow and hesitating; the white wing-band is noticeable. They have not been observed by me to indulge in any flight formations and manoeuvres, such as one sees in the case of certain Plover. They appear loath to take flight and if disturbed they seldom fly far, pitching on some broken stony patch or pebble strewn reach, where on landing, they blend entirely into the terrain and are lost to view. Their plumage is highly cryptic. One most often flushes a small bunch, previously unnoticed, and on pitching, they stand in a huddled position, remaining almost motionless. When flushed they utter a sharp note two or three times, "tche tchit."

Genus *HAEMATOPUS*.

HAEMATOPUS OSTRALEGUS, Linn.

EUROPEAN
OYSTERCATCHER.

Ref. : Linnaeus, Syst. Nat., 1758.

Type locality : Oeland, Baltic.

DISTRIBUTION :

Along the coast of Kenya and occasionally on the inland waters of Lakes Victoria and Naivasha, once on Lake Magadi; and observed on Lake Rudolf.

DESCRIPTION : (Plate 5)

The birds which one most often observes are adults in winter plumage which they have assumed before arrival on our shores, or they are young in the first winter dress. I therefore propose to describe the adults in winter, thereafter indicating the spring change.

Adult, winter : The whole of the head (with the exception of a small patch below the eye, which is white) to the nape, chin, and upper throat, mantle, scapulars and long inner secondaries, lesser and median wing-coverts, black with a slight greenish gloss.

Across the throat, a white band, sometimes extended on to the side of the neck, sometimes on to the chin; lower neck black; back and rump white, as also upper tail-coverts, the latter with slight black tips; tail black distally, basally white; breast and the remainder of the lower surface white. Primaries black with variable amount of white on the inner webs and from the third primary variable white patches on the outer web; outer secondaries white basally with increasing amount of sepia-black on the ends from within outward, inner secondaries white; greater coverts white. Under wing-coverts and axillaries white.

Legs and toes pinkish; bill orange-red with horn-brown tip; eyes vermillion. Wings 245-256 mm.

Spring plumage: A partial moult takes place toward the end of January and continues to March. The chief alteration is the complete elimination of the white throat band, and the darker more glossy greenish of the mantle; the increase in colour of the soft parts.

Sub-adult, first winter: Very like the adults, but tone of black much browner; median coverts with buffy tips much worn; upper tail-coverts barred black; some buffy tips to feathers of the mantle, legs and toes dirty pinkish; bill only slightly orange at the base, rest horn brown; eyes brown.

As the birds do not breed here we will not deal with the nesting habits or eggs.

HABITS:

The Oystercatcher arrives toward the end of September and beginning of October; and migrates north in the first week of April. Though never very numerous, small flocks of twenty or so may be seen in open formation along the coast. They follow the line of the tide when feeding, or frequent the shallow lagoons on the coral reefs. They certainly prefer the more sheltered reaches of the shore line and when not feeding they rest on the low exposed sandy islets. They also show a preference for the sandy and pebbly shore rather than the mud flats of the numerous creeks. They are most active when the tide is receding.

The food consists of crustacea, and mollusca, worms and larvae.

The robust build, pied plumage and orange bills make this bird a conspicuous object on the shore.

Specimens recorded from inland waters have been single or in twos; probably stragglers down the Nile system.

HAEMATOPUS MOQUINI Bp. BLACK OYSTERCATCHER.

This species is recorded as observed on the east coast but its position as a regular visitant is obscure.

RECURVIROSTRIDAE.

Genus *RECURVIROSTRA*.

RECURVIROSTRA AVOSETTA, Linn.

AVOCET.

Ref.: Linnaeus Syst. Nat., 1758.

Type locality: Oeland.

DISTRIBUTION: (Plate 6)

Europe and Asia to Mongolia, and parts of Africa. Migrating to Africa in the winter. Many birds locally resident and recorded on

Lakes Rudolf, Nakuru, Naivasha, and Magadi. Has also been recorded from Lake Victoria.

DESCRIPTION :

Male and female adult : Greater part of plumage snowy-white; top of head from base of bill, and round the eye and down the back of the neck black. A small white patch above and below the eye white; lower part of neck, white; mantle mostly white, with lateral feathers black; inner and long scapulars also black, longest ones white; outer white ones forming a continuous white line with the longest ones; back, rump, upper tail-coverts and tail pure white, the last with slight grey tips to the central feathers. Outer primaries black with white bases, inner ones mostly white; secondaries white except the long inner ones which are shaded sepia to black; margin of wing and bastard wing white; bend of wing white; lesser coverts brown-black to black as also median and some greater coverts, forming a continuous black bar with the innermost secondaries. Bill long and very slender, black, and up-curved; legs and toes grey-blue, eyes red-brown. Wings 220-235 mm.

Sub-adults : Very similar to above but black much tinged with brownish and sepia; crown and forehead mottled with black-brown and whitish; upper tail-coverts with some brownish cross-bars toward tips; coverts black-brown and sepia and tipped with buff. Primaries brownish. Legs dirty bluish-grey. Eyes brown.

Nestling : Jackson recorded the finding of a nestling on the shores of Lake Nakuru. As I have no specimen, I quote from Witherby, *Handbook of British Birds*, p. 650. "Down on forehead cream-white; narrow irregular black-brown line from base of upper mandible to hind-crown; rest of crown pale greyish-buff, irregularly mottled and dotted with tufts of black-brown; nape pale greyish-buff, down with sooty-brown bases; from nape to mantle two irregular parallel sooty-black lines; two irregular black patches on rump; an irregular black-brown line along ulna, another from base of uropygial tuft toward wing; uropygial tuft black intermixed with light buff; rest of upper parts pale greyish-buff intermixed with light buff and sooty-brown; from base of upper mandible through eye, a narrow black-brown line; rest of underparts cream-white intermixed with dusky-brown round tibia."

HABITS :

In Eastern Africa, this species is resident on the lakes Nakuru and Naivasha; and doubtless on others, though I have no personal records of specimens from other lakes during the months April to August.

They are joined during the winter months by migrants from the north so that dates of arrival and departure are thus difficult to ascertain. I have examined birds which are in moult on the wings, along

the primaries, in June and July; others again, shot in May, have many of the wing feathers worn and faded by the action of the soda in the lake.

These birds frequent the more open flats with scattered clumps of reeds and rushes rather than the reed-beds, but during the rains when the grass-lands at the lake side are under water, they feed there. They prefer the shallows over the mud flats and here they walk about with bills just below the surface, rapidly sifting the silt for larvae and other aquatic insects. Worms and small mollusca and crustacea are also taken. Never very numerous, these birds are conspicuous and easily recognised by their striking plumage. They are usually seen in pairs or small bunches of half a dozen, not in flocks. When disturbed they get up with a clear whistling call like "kluwit" oft repeated; their blue legs hanging pendent if the flight is short, and held out behind if sustained.

They undoubtedly nest on the mud flats, but I have not taken the eggs. They are described as sharply pointed at one end, dirty-buffy in ground colour and blotched with dark-brown to black. Two eggs are reported, occasionally three.

Genus *HIMANTOPUS*.

HIMANTOPUS HIMANTOPUS, Linn.

BLACK-WINGED
STILT

Ref. : Linnaeus, Syst Nat., 1758.

Type locality : Southern Europe.

DISTRIBUTION : (Plate 7)

On all the larger inland waters of Kenya and Uganda, the majority as winter migrants, though numbers are local residents.

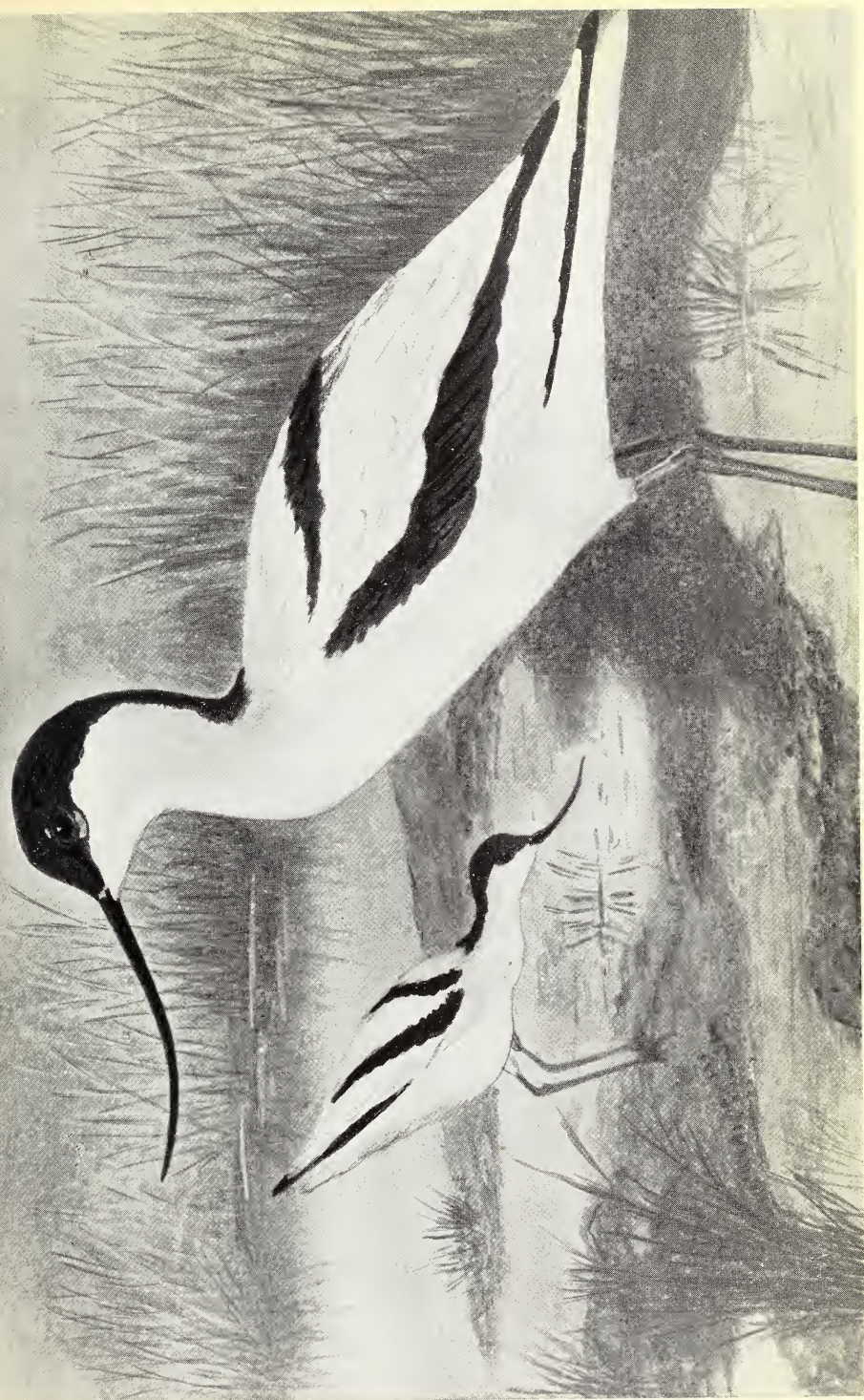
DESCRIPTION :

Male adult : Forehead, fore part of crown, lores, cheeks, and a spot under the eyes, chin, throat, fore-neck, and the whole of the undersurface of the body white; hind-part of crown, nape, ear-coverts, and hind neck to mantle white tinged with pale grey, or ashy-grey slightly darker on the head. Mantle and scapulars black with a strong green sheen; wing-coverts, secondaries, and primaries similarly coloured, and slightly more brownish on the inner webs of the latter two. Back and rump pure white; tail ashy-grey to pale grey, the outer ones white; long upper tail-coverts pale grey. Bill black; legs and feet pinkish-red; eyes crimson, or red-brown.

Female adult : Somewhat like the male but top of head and hind neck more ashy, wings less glossed with green; mantle and scapulars









BLACK-WINGED STILTS. (*Himantopus himantopus* Linn.)

and long inner secondaries ashy-grey-brown, the mantle feathers somewhat pale tipped.

Adults in winter plumage differ somewhat from summer birds in the colouration of the nape and neck the tone being a more uniform ashy grey, the males losing the blackish tips to the feathers of the crown.

Immature: General scheme of colour pattern as adults; crown, nape, and hind neck ashy-brown to sepia; mantle and scapulars ashy-sepia with pale tips to the feathers; wings black with wide sepia tips; under-wing coverts sepia with buff tips; primaries and secondaries blackish brown, the inner primaries and secondaries with white tips and inner margins to inner webs; upper tail-coverts with sepia end bar; legs and feet dull flesh-brown; eyes brown; bill black at tip, brown at base.

Nestling: The downy plumage has not been seen by me and I take the liberty of quoting Witherby: "Down on fore-head light buff; from base of upper mandible to hinder crown a black-brown median line; . . . rest of crown light buff, with irregular lines and small dots and tufts of black-brown; nape light buff, down with sooty-brown bases; rest of upper-parts, sides of neck, and sides of body light buff with irregular and indefinite and variable black-brown markings, sometimes tending to form two irregular bands down mantle and back; an irregular band from uropygial tuft along sides of lower back, down around tibia intermixed with sooty-brown; uropygial tuft black-brown, down with buff tips; from base of upper mandible through eye a black-brown line; eye-stripe light buff; remaining under-part white."

HABITS:

The Black-winged Stilt frequents practically all open expanses of water where there are mud or sandy banks along the fore-shore. They have been known to take up temporary residence on dams and artificial lakes, and even to take advantage of temporary water and swamps formed during the heavy rains.

They are never very numerous, and do not appear to associate in flocks; one sees two or three birds here and there or possibly half a dozen. There is no doubt that the local birds are resident and breed, for year after year one has noted them during all months and by their behaviour they have been nesting. My collectors reported young on Lake Koroli in July. Adult males with enlarged breeding organs have been taken in May.

The species has been noted in greatest numbers on Lake Rudolf (south end) on Lakes Nakuru and Naivasha, Elmenteita, Olbolosat, Lake Koroli, and Marsabit; temporary swamps in the Southern Masai

Reserve, Nairobi swamp, on dams in the Lumbwa-Sotik area, and on the lakes in Uganda.

They feed in the shallows as they walk leisurely along, disturbing the bottom by lateral movements of the feet, but the food is picked off the surface of the water. It consists of various insects, dragon-fly larvae, larvae of water-beetles, fly larvae and small mollusca and crustacea. In captivity, I have fed them on very small worms and tadpoles.

They are not quick flyers and their flight is not sustained; they soon alight. In flight their long red legs are conspicuous and appear as red streamers behind them. They dislike deep water, much preferring the shallow bays which are free from reeds and snags. If, however, they are compelled to take to deep water with bottom beyond the reach of their feet, they can swim remarkably well.

Family DROMADIDAE.

Genus *DROMAS*.

DROMAS ARDEOLA, Payk.

CRAB-PLOVER

Ref. : Paykull, K. Vet.-Handl., 1806.

Type locality : Coast of India.

DISTRIBUTION :

The coastal line of Eastern Africa.

DESCRIPTION : (Plate 8)

Male adult : The whole of the plumage pure white except for the following areas : a jet black patch commencing at the base of the hind neck expands over the mantle and scapulars, forming a " saddle " ; the tips and outer webs of the primaries black, shading to ashy and white on the inner webs ; the greater coverts similarly coloured ; the rectrices slightly tinged with ashy-grey.

Female adult : Very similar to the male but the black does not extend so far on the long scapulars.

Both sexes have black bills, horny at the very tip ; legs and toes blue-grey ; eyes brown ; length of wing 205-220 mm.

Juvenile : Differs from the adult as follows : the top and hinder part of the crown is streaked with black ; the mantle area is only slightly tinged with black on an ashy-grey ground, which colour extends over the whole of the wing except the primaries, secondaries and greater coverts which are dull blackish on the outer webs and whitish to ashy on the inner webs. The tail is also more ashy-grey.

Nestling : We have not taken the bird in this stage, but it is described as covered in an ashy-grey down slightly mottled on the dorsum.

HABITS :

The Crab-plover is a common species along the coast, especially so from the mouth of the Juba River to south of Mombasa. It occurs in small parties or large flocks and is a conspicuous bird; the brilliant black and white plumage shows up strongly. They are by no means shy and with care can be approached to within quite short distances. There should be no difficulty in recognising the species, for their blue-grey legs, strong stout bills, and general build set them apart from any other waders along the shore. In general behaviour they resemble Stone-Plovers; they have the same habit of standing almost upright with the head drawn in between the shoulders, and they run along the shore for some distance before taking wing, if approached too closely. They appear to be equally at home either on the exposed reefs when the tide is out, or on the sandy reaches at high tide. They, however, seek most of their food among the weeds on the reefs, or among the debris at high water line. The food consists of crustacea and small mollusca, marine worms, and often small fish from the shallows.

The nesting habits are peculiar, for this species nests in burrows where one or two eggs are laid. They are large for the size of the bird, pure white with a matt surface. 43 x 52 mm. No nesting burrows have been recorded along the Kenya coast.

Family ROSTRATULIDAE, Lowe.

Genus *ROSTRATULA*.

ROSTRATULA BENGHALENSIS, Linn.

PAINTED SNIPE.

Ref. : Vieillot, Analyse, 1816.

Type locality : Asia (India).

DESCRIPTION : (Not figured)

In suitable localities throughout Kenya, from the coast belt to altitudes of 10,000 feet, and in Uganda.

DESCRIPTION :

Male adult : Top of crown grey-brown with a central buff stripe running from base of bill to nape, feathers on either side of this white tipped; a buff ring round the eye and extended back toward, but not reaching the nape; ear-coverts grey-brown slightly white streaked; cheeks and throat whitish with very small blackish streaks; lower throat and sides of neck more boldly streaked blackish and white;

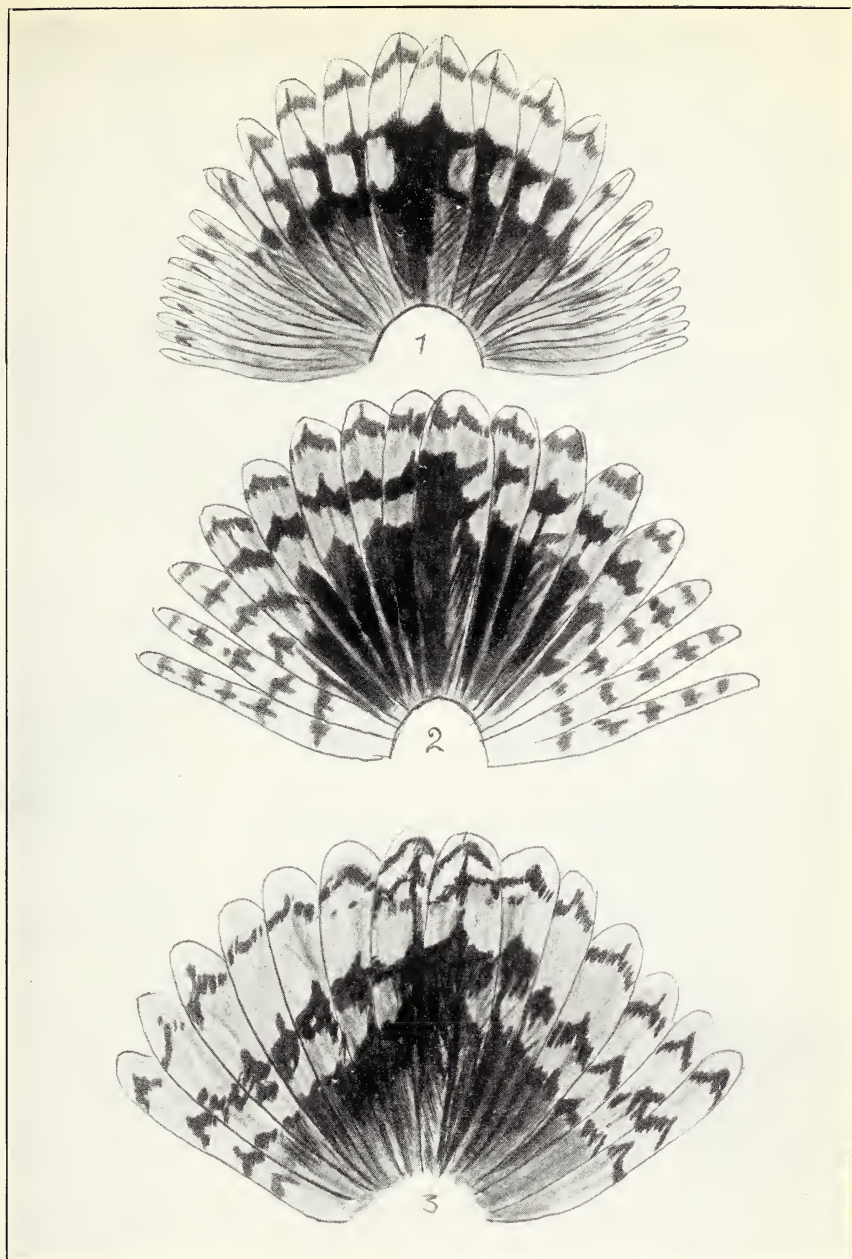
upper breast and lower hind neck and upper part of mantle ashy-grey-brown with fine blackish wavy barring broadest on the breast and many of the feathers with white tips; lower breast white, the white extending up on either side just in front of the wings and just behind this a few strongly barred black and buffy white feathers; underside of body to vent and under tail-coverts white, the last slightly buffy; mantle and scapulars olive-grey, with strongly marked golden buffy line on outer webs contrasting with deep olive-black shaft line and inner webs which have one or more pure white cross bars; short scapular feathers with broad olive-black bases, followed by a white bar outlined in black, and ends olive-grey, edged white. Back and middle of rump grey with blackish bars and white tips; lateral rump white; upper tail-coverts grey with black cross lined two series curved to enclose lateral greenish-buffy circular spots, tips white; tail feathers grey with narrow black cross lines each feather with three golden-buffy oblong spots on either web outlined with black, tips buffy-ochreous.

Wings : Primaries grey in ground colour with wavy broken narrow black barring, with two black patches on the outer webs and a series of somewhat circular golden-ochreous spots outlined in black extending the width of the outer webs; inner webs with white tooth marks. Secondaries grey in ground colour, with narrow black cross bars, ochreous spots on the outer webs and buffy to white streaks on the inner webs; the long inner secondaries washed with olive and finely vermiculated with black toward the ends which are crossed by olive-black bars accentuated with white and by ochreous bars; greater and median coverts greyish at base and distally olive-ochreous with two or more golden-ochreous cross bars accentuated with black; lesser coverts greyish washed with olive distally and with some ochreous spotting. Under wing-coverts and axillaries white. Wings 125-130 mm. Bill 45 mm, slightly enlarged and down-curved at the tip; pale brown slightly darker at the tip, and more yellow at base of lower mandible. Legs and toes olive-grey. Eyes brown.

Female : Top of crown olive-brown with purple tinge, some black barring and whitish tips; centre of crown with ochreous stripe edged with black and rusty colour at base of bill; a conspicuous white ring round the eye, the white extending back over the ear-coverts, the whole accentuated by a border of black; rest of head and neck chestnut, paling on the throat and chin; darkening toward the upper breast where it shades into a broad black chest band accentuated by a white bar which passes up toward the bend of the wing and behind these " horns " a blackish-olive patch shot with purple; the rest of the underside pure white. Mantle olive-grey with slight purple sheen, the lateral feathers with longitudinal ochreous streaks on the outer webs accentuated internally by jet black, the rest finely vermiculated with black. Scapulars like the mantle but with incomplete black cross



EUROPEAN COMMON SNIPE (*Capella gallinacea gallinacea* Linn.)



Diagrammatic sketches of Tails of Snipe.

1. Indian Pin-Tail.
2. African Snipe.
3. European Snipe.

van Someren.



barring set widely apart, the long feathers olive washed and white tipped; from the basal scapulars are three pure white, narrow, long plume feathers which, when displayed curve down over the coverts. Wings: Primaries and secondaries very much as in the male but more blackish on the outer webs of the former; the long inner secondaries are, however, greyish with a strong greenish wash, finely crossed-banded in black and with two to five more pronounced black cross bars. Greater coverts black basally, olive distally, with narrow black cross bars; median and lesser coverts olive, with bronzy sheen and fine black cross barring. Back, rump, and upper tail coverts as in the male, but tail feathers more greyish in ground colour, with less conspicuous ochreous bars which are narrower but usually extending right across.

Immature: Even in this stage the sexes are differentiated, but there is a predominance of the male colouration. The dorsal ochreous lines are not so marked while the white tips to the scapulars and long inner secondaries are tinged with buffy and the marks on the wing coverts are not so olive. The brown neck and breast of the female is gradually assumed but is mixed with olive-grey, and the black chest band is flecked with grey and white.

Nestling: The chick in down is ochreous-grey with a chestnut brown line on the crown and side of the head; the back has a central line of chestnut bordered by black, and on the sides from the scapulars a darker brown line; the wings with two black bars; under side buffy.

HABITS:

The Painted Snipe is essentially a bird of swamp and swampy margins of streams and rivers and lakes. Not only are they to be found in reed-beds but also in the midst of thick papyrus amongst which are open pieces of water. One may frequently put up one or more birds from a papyrus bed with the aid of a dog, but one can seldom recover a shot bird if it falls amongst tall papyrus. When flushed in reed-beds the birds get up with a clumsy flight, rather flopping, and make an easy target. One cannot say that they give one a sporting shot; quite the reverse.

They have a very wide distribution, being found from the coast right up to the highlands up to 10,000 feet, and in suitable localities throughout Uganda. They are undoubtedly local migrants, but the governing factor seems to be food supply dependent on the state of the water level of the swamps. They feed entirely on larvae, worms, and small mollusca, with some grass-seeds. They are by no means clean feeders, for one of the chief places in which to find these birds is just where the Municipal sewerage system empties into a river (Nairobi area). One sees them here in twos or small family parties, not in flocks or whips, and for the most part they are sluggish unless suddenly flushed.

In spite of their distinctive plumage they nevertheless are cryptic and quite difficult to spot, even though one has noted exactly where a bird has pitched. On landing, they seldom run or hide, but stand stationary amongst the reeds and may thus escape observation.

The African bird was at one time considered distinct from the Indian species but is now generally accepted to be identical, but I am personally doubtful about this. If they are identical, the distribution would be from South Africa, through Eastern Africa to India, Ceylon, and Malaya. Our birds are resident and breed throughout their range.

The nest is a shallow depression at the edge of a swamp, not far removed from water, and usually sheltered by an adjacent clump of reeds or herbage. Two eggs are usually laid, occasionally three. The ground colour is ochreous to ochreous-grey, with bold black-brown blotches, lines and spots, averaging 25 x 32 mm.

On the two occasions on which I have found the nests, the male bird has been flushed from it. It is recorded that the female, and more brightly coloured of the two sexes, does not take part in incubating the eggs. Of this I have no personal knowledge, nor can I vouch for the statement that it is the female which does the courting, but such is said to be the case.

From observation, it would appear that a pair will occupy a given territory and remain there if undisturbed, their number not being added to except during the breeding season when the young are hatched, but when these are strong on the wing they are driven off. I have had one particular small swamp under observation for years and have never found more than one adult pair in occupation. On one occasion when the pair were shot the swamp remained untenanted for a month and then another pair took possession.

The male birds flushed from the nest were close sitters and only left the nest when approached to within a foot. One nest had eggs about to hatch, and the parent remained close by and flopped about as though wounded.

With the advance of settlement and drainage of swamps in the Nairobi area, these birds are not so plentiful as formerly.

Family SCOLOPACIDAE.

Genus *CAPELLA*.

CAPELLA GALLINAGO GALLINAGO, Linn.

COMMON
EUROPEAN SNIPE.

Ref. : Linnaeus, Syst. Nat., 1758.

Type locality : Sweden.

DISTRIBUTION : (Plate 9)

Kenya and Uganda. A migratory species from Europe.

DESCRIPTION :

Male and female, adult : Head pink-buff with two lines of black-brown running from the base of the bill to the nape; a further dark streak from the bill, through the lores and eyes; eyelids white; cheeks slightly streaked with brown, the dark streaks pronounced on the ear-coverts; nape band pink-buff; chin and throat white to pink-buff; back of neck blackish-brown, each feather with lateral notches of cinnamon-buff; fore-neck and upper breast sandy buff with obscured brown streaks and inverted V marks; lower breast, belly to vent white, the flanks with wide irregular brown barring; under-tail-coverts buffy to white with irregular brownish bars; mantle and inner scapulars dark blackish-brown with slight greenish gloss, each feather notched and tipped with tawny-buff; the long scapulars with pronounced borders of pinkish-buff on the outer webs; back and rump blackish-brown with green tinge and white tipped; upper tail-coverts pink-buff with brown-black, irregular bars and whitish tips; tail: centre pair basally dark blackish shading to bright cinnamon with white tip and subterminal blackish bar; from next pair to outermost shading from pinkish-buff to white, with black-brown barring and freckling, bases brownish. Primaries dark brown, paler on the inner webs, first primary very small, second with outer web white or buffy, next only narrowly white; secondaries brown-black, with broad white tips and some whitish mottling on the inner webs, long inner ones with barring and mottling of buff on the outer webs; greater coverts black-brown with white tips, and paler on the inner webs which are irregularly barred and freckled with buffy; median coverts black-brown with olive tinge, tipped white or buff and some freckling; lesser coverts rather darker, especially toward upper margin; margin of wing black-brown with white tips; under wing-coverts and axillaries black and white barred.

Legs and toes olive greenish to yellowish; bill dark-brown with olive base; eyes brown to hazel. Wings 125-138 mm.

Tail fan-shaped; 12-16 feathers, *outermost feathers broad*, about 8-10 mm. Length of bill: males 60-70, females 64-73 mm. (Plate 9a.)

Immature : Somewhat like adults but cinnamon-buff on dorsum not so marked; wings more brownish and edges to the feathers and tips wider and usually much worn.

HABITS :

As the species is non-breeding we need not deal with the juvenile or nestling stages. Migrants from the north have been noted to arrive in Uganda and Kenya during the last week of September, but the majority pass in October; some few remain in suitable spots if not harried. The northward move takes place in April, but some late arrivals have been noted in mid-May. Their departure is no doubt influenced by the rains.

The species cannot be called a common migrant, large whisps are unusual; small ones of a dozen are usual. Cf. Solitary Snipe.

They are to be found on most of the lakes, swamps, rivers, and streams and inundated lands, during some period of their migration north or south, but as many of the swamps dry up toward the end of the year, they prove unattractive and the birds move south. They are partial to the marshy edges of the waters where the vegetation is not too thick or long, and are especially fond of places where cattle have been driven to water and the place well trodden and polluted. They dislike deep water.

When aware of danger, they "freeze," standing motionless with heads drawn in to the "shoulders," or they adopt a semi-crouching position. When flushed, they get up and flight in a zigzag way, not very high from the ground, and drop. One can put them up two or three times before they flight high and drop at a distance. They take much of their food by "feel," as they pierce the soft mud with their bills; such food consists of larvae (beetle and dipterous), and worms; other food such as small fresh-water snails and insects are obtained on the surface. They feed mostly at dawn and in the evening.

They are practically silent, but if suddenly flushed will utter a harsh note like "skeep."

CAPELLA MEDIA, Latham. SOLITARY or GREAT SNIPE.

Ref. : Latham, Gen. Synop. Bds. Suppl., 1787.

Type locality : England.

DISTRIBUTION :

A migrant from Europe and Western Asia, migrating to Uganda and Kenya where it is found in suitable localities near water.

DESCRIPTION : (Plate 10)

Male and female adult. Head very similar to that of *C. gallinago*, but bill much shorter. Top of head with a central buffy streak from base of bill to nape; on either side of this, a broad brownish-black streak slightly spotted at margins and reaching to occiput; side of head from lores, cheeks, supercillium, and ear-coverts, buffy to ochreous finely streaked with blackish; a blackish streak through lores to eye; eyelids white or pale buff, and continued back toward nape; chin and throat white; fore, side and hind neck ochreous-buff, the feathers with dark centres giving these areas a streaked appearance; upper breast and sides ochreous-buff with dark cross bars slightly angled, very pronounced on the sides and flanks; lower breast and abdomen whitish; thighs white with blackish bars; under tail-coverts buffy with black central streak and cross bar on outer web enclosing ochreous-buff spots strongly marked.



LEDDICANT CURLEW *Limosa limosa* Linn.





JACK or LEAST SNIFE (*Limnocryptes minima*, Brunn.)

van Someren.



CURLEW SANDPIPER. (*Erolia testacea*, Pallas.)

Mantle and inner scapulars black with wide ochreous-buff border to outer webs, and small ochreous notching on inner; outer scapulars similar, but with more ochreous tawny notching and irregular cross bars; back blackish-brown with whitish to buffy tips to the feathers; upper tail-coverts sandy to ochreous buff with on the lateral ones black hastate centres, the inner ones with angled cross barring; tail: central pair mostly black with terminal $\frac{1}{4}$ cinnamon-orange, contrasting with the black, an irregular penultimate blackish line and buff tip; next pair, black less extensive, cinnamon-tawny bar wider, black irregular bar not so distal and tip white; third pair very similar but more whitish, especially the terminal one-third; others white with black cross bar mostly on the outer web. Tail feathers 16-18, *all broad*. Wings: primaries blackish-brown to sepia, first primary very minute, second with some dentate buffy marks on outer web, shaft yellowish, inner webs paler, tips narrowly white; secondaries: outer ones blackish-brown to sepia with white tips, inner ones with whitish to buffy obscure barring; innermost long ones with conspicuous buffy to whitish margins and tips and irregular buffy barring, the ground colour on the outer webs, black. Primary and greater coverts brownish-black with conspicuous white tips; median and lesser coverts brownish-black with large white tips and sandy bar at base of white; feathers at angle of wing with whitish margin to outer web giving this a streaky appearance.

Legs and feet yellowish-olive or greyish-olive; bill, black at tip, shading to yellowish at the base; eyes brown. Wings 138-149 mm. Bills 58-70, average 64 mm.

Sub-adult: Very similar to adult but less brightly coloured, the black less intense, and the feathers of the mantle and scapulars more mottled and barred with ochreous to buff. Legs and bill duller; eyes darker, more grey-brown. Tail more barred, especially on the outer ones.

As the birds do not breed here, we will not deal with the nestling or eggs.

HABITS:

The Great, Solitary, or Double Snipe arrives in these territories in October, usually about the middle, though some are a bit earlier, leaving again in the beginning of May, though many are observed up to May 28th. Some few have actually been shot at the end of June, and solitary birds as late as July. Though for the most part found in the vicinity of water, temporary swamps, margins of permanent swamps, swampy margins of streams and rivers and the marshy shores of lakes, one may flush these birds from grass land a long way from water. It often happens that when these birds have fed in the shallows they move into the shelter of low scrub and bush away from the water. It is often

the case that when a stretch of swamp has been walked over thoroughly twice, the birds will fly high and land in the grass and bush away from the water and not return for some time.

When these birds arrive, they do so in considerable numbers. The largest flock I personally have seen numbered well over two hundred. They are most in evidence on the northward move, and then may occupy a particular swamp for a week or two before moving on.

On the southward migration the whisps are smaller and more scattered, and if these birds are undisturbed some will remain throughout the winter months. Unfortunately, Snipe are not left alone. It is no uncommon occurrence, however, to find two or three birds along the marshy borders of streams and rivers for four months or more. Some local movement takes place during the birds' sojourn in this country; as swamps dry up they move off to more permanent water. On the whole they are more partial to shallow temporary water than is the Common Snipe.

Their flight is slow and more direct than in *C. gallinago* or the local *C. nigripennis*, in fact it is a heavy flight, and the birds are an easy mark for even a moderate shot. The largest bag I have counted was eighty brace to two guns in an early morning shoot. The flight is not sustained, and the birds literally drop to shelter. In thick grass these birds are sulky, and many have been captured by a dog I once owned. They feed in the shallows, not necessarily on mud flats, picking up insect larvae, small mollusca and crustacea, and worms. I have also known them to take very small tadpoles.

The weight of a full-fed female just before northward migration is over six ounces; the heaviest I have weighed was $8\frac{1}{2}$ ozs. They are always very well covered in fat and the feeding here seems to suit them admirably. However, it must be admitted, they are more "dirty" feeders than their cousins. I have noted several feeding on the fly-larvae infested dung of cattle, and also on the "night-soil" pits outside towns, the shallow trenches of which have been partly inundated with storm water and the surface a wriggling mass of fly larvae!

CAPELLA NIGRIPENNIS Bp.

AFRICAN BLACK-
WINGED SNIPE.

Ref. : Bonaparte, Icon. Faun. Ital., 1839.

Type locality : Cape of Good Hope.

DISTRIBUTION :

Sparsely throughout Uganda and Kenya in suitable localities.

DESCRIPTION : (Plate 11)

Male and female adult : Top of head with a black area, narrow at the base of the bill, then widening out, widest just behind the eyes and

tapering again at the occiput, this black is divided by an irregular buffy line from the bill to the nape; lores, supercillium, cheeks, and ear-coverts buffy-white, the lores with a blackish streak from nostrils through the eye and narrowly above the ear-coverts; cheeks and ear-coverts streaked with black; chin and throat whitish; neck buffy ground colour heavily streaked with blackish, more particularly on the front of the neck, down from the ear-coverts where the ground is more rufescent, and over the upper breast; sides of the breast with wide blackish-brown irregular angled bars; lower breast, abdomen to vent white; under tail-coverts buffy with dark barring and rufescent wash on the outer webs of lateral coverts; thighs mostly white with some dark barring; mantle darker (more black than migrant species), with the lateral feathers edged outwardly with ochreous-buff and some rufous spotting; scapulars similar but marginal ochreous-buff wider and more rufescent and with rufescent spotting; long scapulars more barred with rufescent to buff. Wings: primaries blackish-brown with paler inner webs, white tipped, second primary white on outer web; secondaries ground colour similar and tips broader white, innermost long secondaries with buffy barring mostly on outer web; primary coverts blackish-brown with white tips; median coverts with light tips and some buffy barring; lesser coverts with white tips. Back and rump blackish with buffy spotting shading to rufescent spotting; upper tail-coverts cinnamon buff with angled barring. Tail: central pair mostly jet black basally with a bright rufescent end sometimes a dentate mark of same colour toward mid-margin, a subterminal blackish wavy bar and buffy tip; next pair basally blackish, distal half rufescent with blackish wavy bars; next pair buffy with similar bars, the remainder paling to white with faint blackish bars, the outermost with blackish spots or longitudinal streak, *the two outer ones narrow*. (Plate 9a.)

Wings 125-237 mm.; bill 70-82 mm. Colour of legs and feet olive-yellowish to greyish-olive; bill blackish at tip shading to yellowish at base; eyes hazel or brown.

Immature: Less strongly marked than adults, wings more mottled and barred, some of the mottling extending on to outer webs of secondaries; head less black with light tips; tail less rufescent at the central pairs and more barred blackish.

Nestling: The ground colour of the down is rufescent, slightly paler on the wings; a pale loreal spot, and another under the eye; black down as follows, a spot above the base of the bill; a streak through the lores; irregular bars on the crown and above the eye; a narrow line below ears; two dorsal stripes, a patch on sides of the body; a patch on either side of the chest and a streak along the wings; lower surface of the body paler than upper, but the latter with pale tips to much of the down giving the stippled appearance.

HABITS :

The African Snipe is a bird of the highlands swamps, marshes, and lakes, margins of rivers and streams, and temporary pans.

It is never common anywhere, and beyond family parties, one usually observes them in pairs, not in large whisps. There is some local movement but this is due to drying up of waters and is not a definite migration. I have no records of this species from the coastal belt; on the other hand most records are from 3,000 to 10,000 feet, and sometimes 12,000 on the mountains. Breeding grounds have been located at high altitudes. The nest is situated in a tuft of grass, very well concealed by overhanging grass, and is sparsely lined. Two to three eggs are laid, buff to brown in ground colour, spotted and blotched with dark brown, sepia and with deeper marks of greyish. Average size 36 x 28.5 mm.; shape pyriform.

The breeding season is irregular; we have records in April-June, September, and January, doubtless influenced by the rains and permanence of swampy conditions.

If the parents are flushed from their nest they utter an alarm note, but I have never heard them making the "bleating" sound so typical of the European bird at nesting time.

They are good flyers but less erratic than is the European bird. After being flushed once or twice, they fly high and are difficult to flush again when they have alighted.

In general habits they resemble the Common Snipe, preferring the mud flats with sparse short vegetation for feeding grounds, but they will "lie up" in thicker reeds when resting. In the Nairobi area they are partial to portions of swamps and streams where cattle have been watered and the ground trodden and littered with droppings which are full of fly larvae; the snipe feed on the larvae.

The general diet is an insect one, usually larvae of flies and beetles, and nymhs of small odonata; worms and small crustacea and mollusca.

CAPELLA STENURA Bp.

INDIAN PIN-TAILED SNIPE.

Ref. : Bonaparte.

Type locality :

DISTRIBUTION :

Only recorded from Kenya once.

DESCRIPTION : (Plate 12)

Male adult : A black-brown area on the crown from the base of the bill, widest between the eyes and extending to the occiput, feathers with small rufescent spots at edges; in the centre of this black patch a buff irregular streak just short of the bill and running back to the nape;

supercillium buff, lores more ochreous; a black line from above gape to eye and extended back over ear-coverts; cheeks buffy as also ear-coverts, this latter with a black streak across centre; sides of face slightly spotted; chin and upper throat white; neck sandy-ochreous shading to greyish-buff on the breast, the greyish colour being due to dark bases of feathers, neck and breast streaked and slightly barred with blackish-brown; lower breast and abdomen white, flanks slightly more buffy and with dark grey-brown wavy bars; under tail-coverts buffy, lateral ones more rufescent and barred with blackish; mantle feathers with glossy black centres and wide buffy outer margins; inner scapulars similar, outer ones and long scapulars with glossy black centres conspicuous buffy outer border and rufescent wavy barring. Back and rump grey-brown with whitish to buff tips; upper tail-coverts sandy-buff with white tips and wavy cross-barring. Tail: 26 feathers; central pair basally black with a conspicuous rufous distal end with a subterminal wavy black bar and broad white tip shading to buff at the black bar; next four somewhat similar but rufescent zone not so bright and whitish tip broader; next two narrow and white with cross bars blackish, *outer seven very narrow indeed*, white with black streak. (Plate 9a.)

Wings: primaries deep sepia with narrow brownish edge to second one, whitish tips; secondaries similar, the long inner ones with alternate rusty and black wavy bars, primary coverts deep sepia to grey-black with white ends; greater coverts with wavy whitish to buffy bars; median coverts similar; lesser coverts with pale tips, and buffy bars, those at the upper edge not with bars but with pale edges and tips forming two light lines.

Bill 60 mm., yellowish-olive at base, blackish at tip; legs and feet olive-yellowish; eyes brown; wings 125 mm.

HABITS:

As already stated, this species is recorded from Africa on the evidence of one specimen taken on the Juba River by my collector in 1923. There appears no reason why the birds should not migrate to the east coast, but the only other record in this direction is one from Socotra. I have no personal knowledge of its habits except in Malaya, but they are said not to differ from those of the Common Snipe.

Genus *LIMNOCRYPTES*.

LIMNOCRYPTES MINIMA, Brunn. JACK or LEAST SNIPE.

Ref.: Brunnich, Orn. Borealis, 1764.

Type locality: Denmark.

DISTRIBUTION:

In Uganda and Kenya on margins of lakes, swamps, and rivers.

DESCRIPTION : (Plate 13)

Male and female : Head with a central black area very narrow at base of bill expanding abruptly in front of the eyes and extending to the nape, the black shot with greenish and each feather with rufescent margins; on either side of this black area a whitish buff streak from the mandible to the nape but not meeting the line on the opposite side; through this whitish zone is a blackish line above the eye; lores whitish-buff with a strong brownish streak from the nostril through the eye and above the ear-coverts; a further dark streak starts just short of the gape and extends back to the lower ear-coverts; chin and throat white; front and back of neck buffy streaked with black-brown, the streaks widening on the breast and more so on the flanks; belly and vent to under-tail-covert white, the latter with brownish streaks on the outer and long feathers; feathers of upper mantle brown tipped with white; lower mantle and scapulars black with green and purplish sheen and spotted with rufous and with ochreous to cinnamon, the outer webs with broad buffy margins and slight white tips, the long scapulars more strongly ochreous-buff on the outer webs contrasting with the velvety black on the inner which have rusty subterminal spots; back and rump with strong purple sheen; upper tail-coverts black centrally with rufous spots and wide buff edges, outer ones buff with black shaft streaks; tail pointed, the central feathers long, blackish in the centre with buffy edges and rufescent mottling and white tips. Wings: primaries dark black-brown with faint green sheen, inner ones with white tips, second primary with brownish on outer web; secondaries brown-black with white tips and the inner ones with buff to rusty freckling and barring, tips white; greater coverts brownish-black with olive-brown submargins and buff edges; median coverts very similar, pale tips broader; lesser coverts also similar but with pale edges, especially on the upper edge giving this a streaked appearance.

Bill black at tip, brown to yellowish-olive at base; legs and feet yellowish-olive with grey tinge; eyes brown; bill 38-42 mm.; wings 100-110 mm.

Immature and nestling : As the bird does not nest here we need not describe these stages. The sub-adult is very like the adult but is less glossed with green and purple on the mantle and back; the long scapulars and inner secondaries are more freckled.

HABITS :

In comparison with the Common and Great Snipe, this bird is but a rare migrant. Odd specimens are shot during the winter months and in twenty-five years I have not observed more than that number of specimens. The earliest date noted is October 6th, and the last before northward migration is March 30th.

All the specimens have been seen in marsh ground near lakes, swamps, and dams, on rivers where the grass has not been too rank and where areas of exposed mud provided feeding ground.

Its small size and glossy plumage should be sufficient to recognise this species from any other, furthermore *its tail is long and very pointed* and of a different shape to the Common Snipe.

It has not been noted in flocks, usually an odd bird here and there; not more than half a dozen have been flushed during a day's shoot at Nakuru or Naivasha. We have only noted it above 4,000 feet and up to 10,000 feet. Its flight is quick, not erratic and not sustained; soon drops into the grass and reeds and can be flushed several times. It feeds on insect larvae and worms, small mollusca and crustacea.

Genus *EROLIA*.

EROLIA TESTACEA, Pallas.

CURLEW SANDPIPER.

Ref. : Pallas, Vroeg's Cat. Adumbrat, 1764.

Type locality : Holland.

DISTRIBUTION :

Breeds in the Arctic regions, North Asia. Winter visitor to Kenya and Uganda. Found on coast and also on inland waters.

DESCRIPTION : (Plate 14)

Adults, male and female, winter : Top of head, nape and hind neck, ashy-grey-brown, slightly paler on the nape, each feather with pale edges; mantle ashy-grey-brown with darker centres and pale edges and tips, almost whitish; black and centre of rump ashy-brown with darker shaft streak and pale edges; upper tail-coverts white, as also lateral rump feathers. Tail : central pair ashy-grey-brown with white shafts and pale edges, others more or less white with decreasing amount of ashy-grey at ends from within-out and edges whitish; chin and throat white; supercillium white; a dark loreal streak; cheeks and ear-coverts streaked ashy; upper breast lightly streaked with ashy-brown, more so on the sides; rest of under-surface white. Scapulars ashy-grey with pale edges and dark shaft streak; all coverts of wing ashy-brown with whitish edges; primaries dark sepia on outer-webs of outer ones, inner ones with narrow white edges and all paler on the inner webs, shafts white; secondaries ashy-brown with white edges and almost white inner webs, long ones like scapulars.

Male, spring and summer : Top of head and nape with blackish shaft streaks, whitish edges and tips which wear off revealing a bright rufous-cinnamon; whitish supercillium only slightly indicated; lores whitish with rufescent streak; cheeks spotted with rufescent-cinnamon; ear-coverts rufescent-cinnamon slightly streaked with blackish; throat

and upper breast orange-cinnamon with white tips which later wear off exposing the rufescent colour; lower breast similar but feathers with a subterminal sepia bar more pronounced at the sides; abdomen whitish with many feathers washed with orange cinnamon and with wider sepia subterminal bars; vent and under tail-coverts white with sepia cross barring widely apart; mantle and scapulars, blackish centred and rufescent cinnamon at sides and whitish tipped; long inner scapulars and long inner secondaries similarly coloured otherwise wings much as in winter but white tips to coverts less marked. Back and rump as winter but softer greyish; upper tail-coverts white barred with blackish and some orange-cinnamon proximal to the black bars; tail: generally more ashy-greyish than in winter.

The summer plumage is acquired by moult and many birds have not completed it by the time they leave for the north.

Wings, 120-135 mm. Bill down-curved toward end, 30-42 mm., black; legs and feet blackish.

Birds in intermediate plumage between the two phases described above are to be noted from December to June. Many sub-adult birds remain in their winter quarters until the following spring. Those staying any length of time on Lakes Nakuru and Magadi become very bleached by the action of the soda.

The nestling stage need not concern us as the birds do not breed here.

Sub-adult plumage, first winter: Resembles the winter plumage of the adults in nearly all respects; the general tone of the upper surface is, however, browner, due to the buffy edges and tips to the feathering.

HABITS:

The influx of these birds to Eastern Africa takes place at the end of August, when small flocks appear, to be augmented in considerable numbers at the end of September. By October all the birds have taken up residence in localities suitable to them.

They appear to be as partial to inland waters as to the coast and large flocks may be seen on such lakes as the Crater Lakes of Toro, Lake Kioga, portions of Lakes Victoria, Rudolf, Baringo, and Hannington, Lakes Nakuru, Elmenteita and Naivasha, and Magadi. Some few frequent the rivers and streams of the Masai country. They can at once be recognised when in flight, by the white rump and upper tail-coverts. On the lakes they keep to the flats and mud banks avoiding marshy ground overgrown with vegetation unless there is open shallow water. On the coast they are usually observed on the pebbly and sandy stretches, though when the tide is out they may be seen on the reefs and shallows. They associate in flocks both when resting and feeding;

many of the flocks contain up to a hundred birds. When flushed they rise with a twittering note which is maintained until they alight.

These birds indulge in evening exercises as do many of the smaller plover. They will get up in a bunch and then stream out in formation, and as though at a word of command the whole flock will wheel right or left, and doing this several times will pitch simultaneously on some mud-bank or sandy flat. They usually remain apart from other waders at feeding time but may occupy a sand-bank along with flocks of Ringed Plover and Sanderling.

Feeding takes place in the early morning and evening, but flighting birds may be observed and heard late at night. The food consists of crustacea, small mollusca, insects, and larvae.

The northward migration takes place toward the end of April and beginning of May; occasionally flocks in full plumage may still be here as late as the end of May. These late birds would have to travel to northern Siberia to breed, and return again by September, doing the double journey, and the raising of young all within four months.

EROLIA ALPINA ALPINA, Linn.

EUROPEAN DUNLIN.

Ref.: Linnaeus, Syst. Nat. 1758.

Type locality: Lapland.

DISTRIBUTION:

A breeding species in the northern part of Europe and Siberia, migrating to Indian Ocean littoral and along the east coast of Africa to as far south as Zanzibar.

DESCRIPTION: (Not figured)

Male and female, winter: Upper surface of head to nape, hind neck, mantle and scapulars, ashy-grey-brown with dark centres and slightly paler edges; back and rump darker with ashy-brown edges and tips down the centre, while lateral feathering white; upper tail-coverts similar; sides of face and lores white, the former streaked with ashy and the latter with a dark streak; supercillium white; chin and throat white; breast also white with ashy shading and dark shaft streaks; rest of underside white. Tail mostly ashy-grey with pale tips and central pair with dark shaft streak. Wings: blackish-brown, paler on the inner webs with increasing amount of white toward the base from the 6th inward; secondaries black-brown with white bases and white tips, the innermost short secondaries largely white; coverts dark ashy-brown with pale tips, widest on the greater coverts.

Bill and feet black; eyes brown; wings 105-114 mm.; bill 25-30.

Some birds are found to be in summer plumage before moving north, but the majority observed have moved before the full change has taken place.

Summer: Top of head dark-brownish with black shafts and rufous edged; neck buff with dark streaks and rufescent tinged; mantle and scapulars black-brown with conspicuous cinnamon and rufescent edges; back similar; upper tail-coverts blackish-brown with irregular rufescent margins; tail black-brown with rufescent edges; sides of head whitish to buff with dark brown streaking; supercillium white; chin and throat white, throat streaked brown; breast buffy with heavy black streaking the black increasing on the belly and the flanks with brownish marks; vent and under tail-coverts white with black or sepia spots. Wings as in winter but edges tinged with buffy and rufescent on inner secondaries and coverts.

As the species does not breed in our territories the nestling and juvenile need not be described.

HABITS :

The Dunlin has only been recorded a very few times from Eastern Africa, on both inland waters of Uganda and on the Kenya coast. It doubtless occurs in greater numbers than the records would suggest. It associates with flocks of other small plover and Sanderlings and frequents the same type of ground.

EROLIA MINUTA, Leisl.

LITTLE STINT.

Ref. : Leisler, Nachtr. zu Bechst Naturg., Deutschl.

Type locality : Germany.

DISTRIBUTION :

Northern Europe, breeding in the extreme north; migrating to Eastern Africa in winter where it is to be found on many of the lakes and along the maritime shore.

DESCRIPTION : (Plate 15)

Male and female, winter : Forehead, chin and throat, white; lores ashy, side of face and ear-coverts whitish, the latter streaked ashy; top of head to nape ashy-brown with slightly paler edges; side of neck slightly paler and more streaky; mantle and scapulars ashy-brown with dark shaft streak and paler greyish edges and white tips to long scapulars; centre of back, rump and upper tail-coverts ashy-brown, sides white; wing-coverts ashy-brown with pale edges, slightly darker on the bend; greater coverts strongly tipped white, forming a bar; primaries ashy-brown to sepia with paler inner webs, and white shafts; inner primaries with narrow white on outer webs; secondaries sepia with pale inner webs and some white at base, long secondaries as scapulars; tail, central pair sepia, rest ashy-grey, all with whitish tips; under surface white, with dark shafts to the lateral breast and ashy shading.

Male and female, summer : Forehead, chin, and throat white, with a whitish supercillium and eyelids; side of face white finely streaked with brownish; lores rufescent, this colour extending to the ear-coverts, both dark streaked; crown and nape with dark sepia centres to each feather, broadly margined with rusty and edged with buffy to white; mantle and scapulars with deep sepia to black centres contrasting with cinnamon-orange to rusty border and whitish to greyish tips; long inner secondaries similarly coloured; inner greater coverts and median coverts broadly edged cinnamon; rest of wing as winter; centre of back, rump and upper tail-coverts dark sepia with rusty borders and greyish tips; central tail feathers dark sepia with wide rufescent border, remainder as winter, some of the inner ones with rusty wash on outer webs. Remainder of plumage as winter, with sides of breast tinged with rufescent.

Bill short, straight, slightly enlarged at tip, 17-20 mm., black. Legs and feet black; eyes grey-brown to brown. Wings 90-101 mm.

Sub-adult : Distinguished by the buffy margins to upper feathers from crown to central rectrices, and buffy wash on sides of upper breast. Wing-coverts strongly buffy tipped and bordered, greater-coverts with wide white tips. Such birds are usually seen from August to November.

The moult from winter to spring is a gradual one; many of the adult birds have not assumed full plumage when they leave for the north. Many start to assume spring plumage in January.

The nestling plumage will not be discussed as the species does not breed in these latitudes.

HABITS :

The Little Stint is one of the common migrants to these countries and arrives very early, many being noted in August; the majority however, arrive in September, most of them juvenile, to be followed later by the adults which make their appearance in October.

The juvenile birds are to be recognised by the buffy tone to the upper plumage. Many of the adults are already assuming the winter dress: an ashy-grey plumage as described.

These birds are, in my experience, more common on the inland waters than on the coast. Very large flocks are to be met with on the larger lakes such as Rudolf, Baringo, Nakuru, Naivasha, Elmenteita, and Magadi, and on swamps, and marshy portions of rivers and quite commonly in small bunches on many of the smaller streams of the more open country.

They are the smallest of the visiting waders and are very tame and confiding. They feed largely on insects and larvae (fly and beetle), small crustacea and mollusca, and small seeds.

When feeding they string-out and seek their food along the margin of the water and in the shallows, and when at rest they bunch together in groups, often associated with other waders.

When flushed they rise and twist and turn so as to become almost invisible; their small size and quick flight render them inconspicuous.

It is no uncommon thing to find a few of this species throughout the summer months on some of the inland waters of Kenya; they are probably birds of the previous year which would not breed, and some adults which for some reason have "over-stayed." Birds of June and beginning of August are of these categories. The northward move takes place at the end of April and mid May.

Genus *CROCETHIA*.

CROCETHIA ALBA, Pallas.

SANDERLING.

Ref. : Pallas, in Vroeg's Catal. Adumbrat, 1764.

Type locality : North Sea.

DISTRIBUTION :

As a breeding species, only in the Arctic, migrating to Africa for the winter.

DESCRIPTION : (Plate 16)

Male and female, winter. Fore portion of head and supercillium, white; round eye, crown to nape and upper mantle light ashy-grey streaked with sepia; ear-coverts white slightly streaked at upper part, sides of upper breast washed with ashy and with faint central streaks; rest of underside from chin to under tail-coverts white; mantle and scapulars pale ashy-grey with dark shaft streaks and whitish margins and tips, long inner secondaries darker greyish; primaries greyish-black with paler inner webs, white shafts except at ends, inner ones with narrow white tips and white on outer webs at base; secondaries dark-ashy at ends white basally, the amount of blackish at ends gradually decreasing from out inward, the 9th and 10th being almost pure white, the long inners as long scapulars; primary and greater coverts grey-black with wide white ends forming a distinct bar; median coverts ashy-grey centrally and broadly whitish at borders, lesser coverts darker and with blackish shaft streak, bend of wing almost blackish. Back and rump and upper tail-coverts ashy with dark centres and pale borders, lateral feathers white; tail: central pair dark ashy toward ends, paler proximally, remainder paler ashy-white edged and basally white. Bill black, 23-27 mm.; legs and feet black; eyes brown. Wings 117-125 mm. No hind toe.

Spring and summer : Forehead and supercillium pinkish-cinnamon, crown with black centres broadly edged with pink-cinnamon and fine white tips (tips wear off rapidly), sides and back of neck slightly paler bordered and blackish streaked; mantle and scapulars black centrally with irregular rufescent-cinnamon borders and whitish tips; back, rump, and upper tail-coverts dark centrally, with rufescent borders and pale tips; white laterally; tail as winter, the outer border of outer rectrices barred ashy; lower neck and breast washed with pink-cinnamon, shaft streaks sepia, slight mottling and whitish tips; rest of underside white.

Sub-adult or juvenile : Forehead, lores and cheeks white, lores with slight dusky streak; ear-coverts slightly streaked at upper part; supercillium whitish streaked sepia. Crown sepia with some whitish to buff tips; neck and upper mantle white with dusky sepia streaks; mantle and scapulars dark blackish sepia tipped and edged with buffy and ochreous; back, rump and upper tail-coverts sepia centred with buffy to ochreous borders and white tips, lateral feathering white; tail as winter adult; median coverts mostly buffy with dark shafts; most lesser coverts dark sepia with slight buffy to white tips. Underside wholly white, with slight ashy on the sides of upper breast.

The nestling does not interest us as the bird is only a winter migrant to these parts.

HABITS :

The short straight bill slightly swollen at the tip, feet with only three toes and very pale grey (winter) plumage should distinguish this bird from other small waders. It is to be met with in fair numbers on the inland waters of Kenya and Uganda and in greater numbers along the coast; it is undoubtedly more a bird of the maritime shore than fresh water.

They associate in flocks, often mixed with Ring Plover and other waders, keeping to the water's edge when the tide is in or on the fringe of shallow pools on the coral reefs at low tide.

When resting, they select some exposed sand bank, and most of the birds will face one way, usually into the wind.

When feeding they keep to the margin of the water or walk in shallows up to their "knees," picking up small crustacea and mollusca, larvae of various kinds and remnants of small fish and shrimps.

First arrivals have been noted in September; most birds are in residence by October and remain with us until April or beginning of May. Most October birds are in full winter dress and many seen in April are in almost complete spring plumage. Large numbers of the October birds are juvenile in first winter plumage; they are darker above than adults.

Genus *CALIDRIS*.

CALIDRIS CANUTUS CANUTUS, Linn.

The KNOT.

Ref. Linnaeus, Syst. Nat., 1758.

Type locality : Sweden.

DISTRIBUTION :

Breeding in the Arctic these birds migrate to Africa but only sparingly on the eastern side.

DESCRIPTION : (Not figured)

Adult, winter : Upper surface from crown to mantle and scapulars ashy-grey with dark brownish centres, pale borders and whitish tips ; fore part of head white, this colour extending over the eye ; ear-coverts and side of neck streaked dusky ; loreal streak greyish. Upper breast white with brownish streaks, lower breast ashy-grey with dark shaft streaks ; lower surface of body white, slightly barred brownish on the flanks ; under tail-coverts white with some irregular sepia barring. Back and rump ashy-grey with darker brownish subterminally and tipped white ; lower rump and upper tail-coverts white with irregular sepia barring. Wings : sepia to dark black-brown, paler on inner webs and whitish at bases, the inner ones with narrow white on outer webs ; secondaries similarly coloured with outer margin white, while inner long ones as mantle and scapulars ; greater coverts grey-brown, white tipped ; median and lesser coverts ashy-grey with whitish border and tips, the small ones at upper margin of wing darker blackish and with only narrow pale edging.

I have never noted this species in spring plumage and as it is a very rare migrant to these parts this dress will not be described here. Bill black, legs and feet olive, eyes brown. Wings 160-170 mm. Bill, 30-35 mm. Legs short 30 mm.

HABITS :

Little is known of the movements of these birds in eastern Africa. Few examples have been noted of recent years. Along the coast a few were seen at Kismayu at the mouth of the Juba River ; a small flock was observed on the reefs at Tiwi, but no specimens have been seen recently. In 1906 several specimens were taken on the crater lakes of Toro. Its squat build and short legs, coupled with its greyish fore-parts should distinguish this bird from other shore waders ; on inland waters it might be confused with the Ruffs and Reeves in winter plumage, but the short dark legs as compared with the yellow legs of the Ruff should prevent confusion.

Genus *PHILOMACHUS*.

PHILOMACHUS PUGNAX, Linn.

RUFF and REEVES.

Ref. : Linnaeus, Syst. Nat., 1758.

Type locality : Sweden.

DISTRIBUTION :

Breeding in the northern portions of Central Europe, this species migrates to Africa during the autumn.

DESCRIPTION : (Plate 17)

Winter : Forehead and lores whitish with dusky streaking ; crown and nape ashy-brown with dark shaft streaks and paler edges ; mantle, scapulars sepia-ashy, slightly darker on shafts and ashy-ochreous borders or greyish-ashy edges ; back, and centre of rump and middle upper tail-coverts dark sepia with paler edges, lateral feathering white ; ear-coverts pale ashy grey, streaked with sepia ; chin and upper throat white, lower throat and upper breast ashy-brown with broad white tips ; flanks similarly coloured, and rest of underside white ; tail : central pair ashy-brown with dark sepia shaft streak and blackish at end, outer ones ashy-grey with subterminal darker band and buffy edges and tips ; wings : primaries sepia-brown with inner webs paler and whitish at bases, shafts white ; secondaries with ashy-brown toward ends and increasingly white at bases, and with white on outer webs ; long inner secondaries ashy with darker sepia to black submarginal line and white to buffy border ; coverts dark sepia tipped with white ; lesser coverts ashy-brown with dark shafts and whitish border.

Spring : I have never noted a Ruff in anything approaching full dress just before the spring migration.

The usual plumage just before migration differs from that of the winter in being much more speckled. The top of the head, hind-neck, and sides of the face become spotted with black on a buff ground ; the throat is white strongly spotted with black ; lower throat and upper breast mottled with black ; the lower breast and flanks with large blackish centres to the feathers and pale shafts and white tips ; these latter wear off showing up the black mottling. Feathers of the mantle and scapulars, with buffy edges surrounding purple-black ; long scapulars and long inner secondaries with alternate bars of sandy and black with a large subterminal purple-black spot, tips greyish ; primaries as in winter but inner secondaries with buffy barring on outer webs ; greater and median coverts barred sandy and blackish with grey at ends and white tipped ; lesser coverts like winter, with a dark spot on outer webs and white tipped. Tail as winter, except that central two pairs are alternately barred buffy and blackish, and outer pairs with black spots. There is some variation in the plumages : in some the

light barring is chestnut ; in others white, contrasting with the blackish barring.

Legs and feet yellowish or orange ; eyes brown ; bill brown-black with fleshy-colour toward base, 35-40 mm. Wings, 188-198 in males, 145-159 in females.

HABITS :

This species is a common migrant to Uganda and Kenya, most often met with on inland waters, but also noted on the coast.

The date of arrival is somewhat difficult to ascertain as many birds remain over from the previous winter migration ; thus July and August birds are undoubtedly of this category. The influx has been noted towards the end of September, mostly immature birds, followed later by adults in winter dress, or partial moult, some few still possessing remnants of the "ruff" as evidenced by brown, black, or white feathers. The moult is soon completed.

These waders frequent the mud flats and marshy ground along the lake shores and banks of rivers, avoiding the swampy lush grass, for they prefer the more open areas. Lake Nakuru is particularly frequented by this species, as are also Elmenteita and Lake Rudolf.

They are not found in flocks as are some of the migratory plover, but usually in small parties of three to half a dozen, associating with other waders. Single birds are frequently flushed along the flood banks of streams and rivers.

Their food consists mostly of insects in various stages, worms and mollusca and crustacea. Seeds of waterweeds are also eaten, such as rumex, and grass seeds.

Genus *TEREKIA*.

TEREKIA CINEREA, Gould.

TEREK SANDPIPER.

Ref. : Guldenstadt, Nov. Comm. Petrop., 1775.

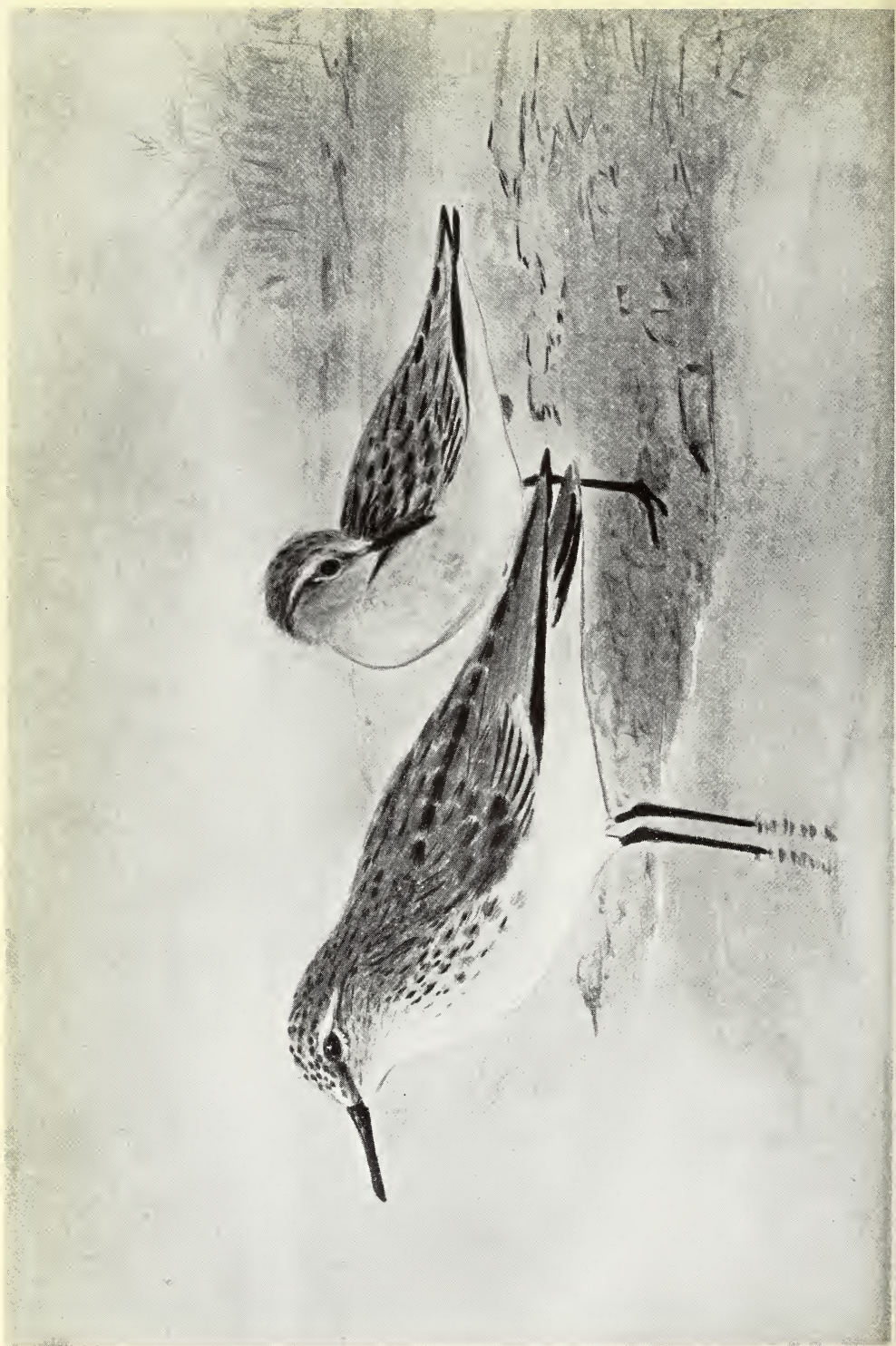
Type locality : Terek River, S.E. Russia.

DISTRIBUTION :

A migrant from Northern Europe and Asia, and wintering on the coast of India and Africa.

DESCRIPTION : (Plate 18)

Winter : Forehead, lores, cheeks, and throat, white ; crown nape, hind neck, ashy-grey with fine dark shaft streaks ; mantle and scapulars, ashy-grey with dark shaft streaks, almost black on the long scapulars ; back, centre of rump and upper tail-coverts ashy-grey, later feathering









white; tail ashy grey; later upper tail-coverts with dark submarginal bordering; upper chest whitish streaked with blackish, lateral aspect shaded with ashy-grey and with dark shaft streaks; rest of underside white. Primaries sepia-blackish, inner ones paler; secondaries ashy-brown-grey at base with wide white ends forming a conspicuous bar; greater coverts dark-ashy with wide white tips; median coverts paler ashy-grey, and lesser coverts slightly darker ashy.

Spring: The moult takes place in January and extends up to the time of leaving; very few birds are in full dress when due to leave. The chief difference compared with winter dress is the arrow-like blackish centres to the feathers of the mantle and scapulars, and more strongly streaked head and sides of the breast; the general plumage is a cleaner grey, though still ashy tinged.

Bill long and *up-curved* 48-53 mm. long, yellowish at base and brown-black toward tip which is broadened and slightly hooked. Legs and feet yellow to orange; eyes red-brown.

HABITS:

This interesting bird is not commonly met with. A few examples have been noted along the coast of Kenya especially north of Mombasa where they frequented the reefs when the tide was out. Others have been noted and collected on the Juba River as far up as Dolo.

They were particularly plentiful just before the northward movement at Lamu and Manda in March and April. They associate with other waders and plovers but can always be recognised by their up-curved bills, and slender graceful build. They feed along the edge of the water taking small crustacea and mollusca and aquatic insects. In general behaviour they resemble the Sandpipers.

The wide white wing bar helps to distinguish this species, when in flight, from other Sandpipers.

Genus *ACTITIS*.

ACTITIS HYPOLEUCOS, Linn.

COMMON EUROPEAN
SANDPIPER.

Ref.: Linnaeus, Syst. Nat., 1758.

Type locality: Sweden.

DISTRIBUTION:

Europe and Asia in summer, migrating south in winter and widely distributed through Africa, particularly plentiful in Kenya and Uganda. Also resident in East Africa.

DESCRIPTION : (Plate 19)

Male and female : A white stripe above and below the eye from base of bill ; a sepia loreal streak ; cheeks and side of neck white streaked with fine blackish, throat white ; crown, nape, olive-brown with sepia shaft streaks ; mantle, scapulars, back and rump olive with a bronzy sheen, with sepia shaft streaks, subterminal dark bar and buff narrow tips, the long scapulars and long inner secondaries with dark mottling and incomplete barring ; upper tail-coverts similar ; tail olive-brown, in central area with white tips, incomplete dark barring and dentate marks, outer pairs white with sepia barring more sparse on outer webs ; lower throat white with sepia streaks, sides of breast washed with ashy-grey and with sepia shaft streaks, rest of lower surface white. Wings : primaries sepia with narrow white tips, and a white patch on the inner webs from 3rd inward ; secondaries sepia tipped white and with a conspicuous white bar across middle ; greater coverts sepia with slight darker barring and broad white tips ; median coverts olive brown with dark barring and buff tips with some buff dentate marks at edges ; lesser coverts more strongly barred olive-brown blackish and buff.

There is some variation in plumages of the adults : some are more strongly bronzy-olive giving a general browner tone to the upper side ; some have the subterminal dark barring of the scapulars and mantle broad and the shaft streak equally conspicuous, thus giving a mottled appearance to the upper side ; others again have the dark markings very narrow and less conspicuous rendering the upperside more uniformly olive.

Bill straight, 23-25 mm., dark brown, yellowish at base of lower ; legs and feet olive-grey, or greenish-grey ; eyes brown. Wings 105-115 mm.

The immature birds are to be distinguished by their more whitish barring at the tips to the mantle, scapular and wing coverts ; the tips of the upper mantle and nape to crown being tipped with buff ; tail feathers tipped buff.

Nestling in down : A dark central line from base of bill over the crown, down the hind neck to back where it widens in the inter-scapular regions ; above the eye a buffy to whitish area slightly dark mottled ; a black streak running through the eye from gape to ears ; eyelids white ; cheeks and throat and all the underside white ; wings except tips which are white, back and tail mottled buffy and black tips ; legs and feet grey-green.

HABITS :

The Common Sandpiper is to a certain extent resident in both Kenya and Uganda, and even breeds here. It is, however, mostly a migrant to these countries from Europe and Asia. The majority of visitors from the north have put in an appearance by September and

October and distribute themselves on most of the lakes, artificial waters (such as dams), rivers and streams. Never in flocks—though several may be noted within a short stretch—they occur in twos or threes along the shores of the lakes or single birds may be noted on streams and rivers, and often on temporary water pans either on the plains or alpine regions (Aberdares, 10,000).

Their characteristic jerky interrupted flight, bobbing, and up and down movement of the tail, at once make these birds recognisable.

They are not by any means confined to inland waters, for they are equally common along the coast; not so much on the actual sea front as along the tidal creeks and mangrove swamps.

They keep to the more open banks and shallow water, and on waters where water-lilies are plentiful they spend most of their time on the large flat surfaces of these plants, rather than on the shore.

The food consists of insects and their larvae, mollusca and crustacea captured along the water's edge. Areas covered in water-lilies prove a good hunting ground, and here the small larvae and pupae of the " damselflies " are much sought after.

The nest and young have been recorded in Uganda in June, and birds in breeding condition have been shot in Kenya in May. The nest is a scrape in tussock grass or by a clump whose leaves hang over and give shade and protection. The eggs are buff to reddish, with darker red and brown spots and blotches toward the larger end. The nest is sparingly lined with grass fibre and odd leaves.

We have taken or observed these Sandpipers throughout all months of the year on Lakes Nakuru and Naivasha, but the bulk have gone north by the end of May.

Genus *TRINGA*.

TRINGA OCHROPUS, Linn.

GREEN SANDPIPER.

Ref. Linnaeus, Syst. Nat., 1758.

Type locality: Sweden.

DISTRIBUTION :

North Europe and Asia in the summer, migrating to the south in autumn and common in Kenya and Uganda during the winter.

DESCRIPTION : (Plate 20)

Male and female adult, winter : Crown, nape to upper mantle olive-grey-brown with dark shafts; lores and supercillium white, the former with a dark streak through the eye to the upper ear-coverts; cheeks white with blackish streaks; throat white. Mantle and scapulars and

long inner secondaries, back and upper rump olive-grey-brown with a more olive tinge on the scapulars, each feather with dark shaft streak, alternate dark and buffy spots along margin and an incomplete dark subterminal bar; the whole upper surface has therefore a spotted appearance. Lower back and rump as back but tips whitish; upper tail-coverts white; tail mostly white with increasing number of blackish bars from second outer to mid pair. Lower throat and centre of breast white with sepia streaking, sides of breast washed with grey-ashy and alternately barred buffy and dark grey or streaked. Rest of underside white. Under wing-coverts and axillaries black with narrow white cross bars. Wings: Primaries blackish with olive sheen, inner webs paler; secondaries olive-blackish, greater and median coverts olive-black-brown, with some paler spotting on the medians; lesser coverts olive-brown with small buffy marginal spots alternating with dark spots.

Bill black, greenish at base 33-35 mm. Legs and feet olive-green; eyes brown. Wings 135-150 mm. Females the larger.

Summer: In both sexes, the most noticeable change is in the more boldly streaked head and neck, the more conspicuous white to buffy spotting on the mantle and scapulars and the more boldly streaked sides of the breast.

Sub-adult: Very like winter plumage, but general tone less olive tinged and the spotting more buffy and grey-tipped. The lower throat and sides of breast more washed greyish and finely streaked.

HABITS:

As with most other Sandpipers, these birds are partial to mudflats and banks on lake shore and rivers, dams, and temporary water pans, and along streams. Most numerous on the larger lakes, one nevertheless frequently meets single examples on the alpine streams and marshes. They may be distinguished in flight by their dark wings, without a white bar, and very white tail with black-barred area limited to a triangle centrally. When handled, the black underwing coverts with narrow white bars are a distinguishing character.

These birds are exceptionally restless and shy and get up at the slightest alarm. As they rise they utter their characteristic call of three notes like "tui tui tui" sharp and high pitched. The flight is not sustained but is erratic and swift. If flushed more than twice it will fly off and circle round, but if the water is limited one may count on the bird eventually returning to the same spot from which it was put up.

They appear to select certain types of marsh or lake-side on which they resort day after day—probably a matter of feeding—and one may find the birds there at almost any time; so also certain stretches of a stream are frequented, places, for example, where cattle have been led

to water, where the ground has been trodden and small puddles formed at the water's edge, and the ground littered with droppings. Here one will note the birds feeding on the fly maggots which breed in the dung. Other food, such as insects and larvae, mollusca, and small crustacea are taken at the water's edge of mud flats.

One does not see these birds in flocks; many, however, may be seen scattered over a suitable stretch of lake front. They do not frequent the water-lily covered parts of the lake as do the Common Sand-piper but are more partial to mud and sand banks.

It is a common migrant and has been recorded on all the lakes of Uganda and Kenya and most of the rivers where exposed flats have been formed during flood time.

Though many examples have been noted throughout the entire year in Kenya, the species is not known to breed here. The time of influx of birds from the north is during the latter part of September, and the northward move takes place in April and May.

TRINGA STAGNATALIS, Bechst.

MARSH SANDPIPER.

Ref. : Bechstein, Ornith. Taschenb., 1803.

Type locality : Germany.

DISTRIBUTION :

Breeding in Siberia and eastern Europe, this species migrates south in the autumn, many frequenting the lakes of Uganda and Kenya during the winter.

DESCRIPTION : (Plate 21)

Male and female, adult, winter : Whole of the front of the head white with a supercillium of the same colour extending back to upper ear-coverts; ear-coverts white streaked sepia; top of head ashy-grey streaked sepia and white tipped; nape, mantle, scapulars, and long inner secondaries ashy-grey with dark shafts and conspicuous white tips and narrow white edges; sides of neck, throat and whole of under-side white; back and rump white; upper tail-coverts white with sepia to blackish freckling on the outer webs. Wings : primaries sepia-blackish, outer ones darker, second with white shaft, paler on inner webs and slightly freckled; secondaries more ashy-grey-sepia with narrow white outer margin and white tips, long inner as scapulars; greater coverts like secondaries, median, and lesser coverts ashy-grey-brown with black shafts and white tips. Under-wing-coverts and axillaries white.

Summer : Male : The chief change is a profuse black spotting and mottling of the upper plumage and breast. Throat, front of neck and breast spotted with round sepia spots changing to wavy barring on the

flanks; crown with conspicuous black central spot and ashy-grey edges, neck streaked blackish and white; mantle conspicuously spotted with blackish, margins and tips grey; scapulars grey-buff with black shafts, black transverse incomplete bars and zig-zag marks to margin, tips white; wings as winter, except that median coverts now have conspicuous black subterminal irregular bars and white tips; lesser coverts grey with white tips; back and rump white; upper tail-coverts more black barred; and tail feathers, particularly central ones with sepia bars and sub-marginal line. In some specimens the general tone of the upper side is tinged pinky-buff.

Sub-adult: Very like winter birds but general tone of upperside less grey more tinged brownish.

Legs and feet greenish-grey; long and slender. Eyes brown; bill slender and long 38-45 mm., slightly up-curved.

HABITS:

The marsh sandpiper makes its appearance in Uganda and Kenya toward the end of September and beginning of October, odd birds being noted here and there on the larger lakes, swamps, dams, rivers and streams. In general habits it resembles the Green Sandpiper, but from this and others it can at once be distinguished by its very long slender legs, long bill, and paler plumage; also by its white back and rump as it flies.

The localities frequented by this species resemble those enumerated for the Green Sandpiper, but it is less often noted on upland streams. They dislike deep water and for this reason are found at the shallow edges of lakes and swamps, on mud flats and sand-banks. On Lake Rudolf they are plentiful, but never in flocks.

They associate with other waders at feeding time and take most of their food in the shallow water. Stomach dissection reveals the presence of insect larvae of various kinds including Diptera and Coleoptera, small mollusca and crustacea.

When flushed, they rise with a high pitched "tuit" repeated twice in succession; the flight is jerky and the long legs are left trailing and pendent, for the flight is not long sustained if the birds are not over-disturbed.

There is a certain degree of congregating as the northward migration approaches; this takes place in April. The birds breed in Siberia and Russia and eastern Europe in May, so that examples noted in Kenya and Uganda after that date are probably non-breeders or birds of the previous season. We have records of specimens taken in May to August, but all are sub-adult or ill-conditioned adults.

All these migratory waders are exceptionally fat and heavy due possibly to the good feeding, but many are infested with intestinal worms which no doubt undermine the general tone.

TRINGA GLAREOLA, Linn.

WOOD-SANDPIPER.

Ref. : Linnaeus, Syst. Nat., 1758.

Type locality : Sweden.

DISTRIBUTION :

Breeding in Northern Europe and Asia; migrating south to Africa and South Asia and Australia for the winter.

DESCRIPTION : (Plate 22)

Male and female, adult, winter : Top of head sepia-olive slightly darker along shafts and pale edged; nape and hind-neck similar; a distinct white streak over the eye from nostril to above the ear-coverts; loreal streak sepia; eyelids white; cheeks and ear-coverts white streaked with sepia; throat white; breast, particularly sides, washed ashy-grey with slightly darker shafts; rest of underside to vent white; under tail-coverts white with slight sepia to blackish barring; mantle sooty-sepia with dark shafts and whitish lateral spots; scapulars and long inner secondaries sooty-sepia with blackish shafts alternate dark and whitish notches along margins and white tips, the long scapulars and secondaries with dark cross bars. Wings : primaries black-brown, second with white shaft; paler on inner webs, which are slightly freckled; secondaries slightly paler than primaries white margined and tipped, long ones as previously described; primary coverts as secondaries; greater with wider white tips, median and lesser white tipped and with white lateral notches. Under wing-coverts and axillaries white with slight black barring. Back, rump, and basal upper tail-coverts blackish with white tips and marginal spots; rest of upper tail-coverts white with black shafts; tail : central pair black and white barred, others with black barring diminishing in extent to outer ones which have black only on the outer webs.

Wings 120-130 mm., females larger. Bill black-brown with greenish base, 25-30 mm. long; legs and feet olive-green.

Summer : Somewhat like winter, crown feathers with darker centres, white tipped and margined; nape and hind neck more streaked white; mantle with darker shaft line and margins notched white; breast with dark shaft streak and often sub-marginal sepia bar, flanks with sepia irregular barring. Undertail coverts with black shafts; rest of plumage as winter. The general effect is a more barred and mottled appearance to the upper side and breast.

Sub-adult : Very like winter birds but general tone browner and pale notching to feathers rather buffy; upper tail-coverts more barred; breast less greyish more sepia streaked; wing coverts with buffy tips and lateral notches.

HABITS :

The Wood-Sandpiper arrives in its winter quarters towards the end of September and early October. Most of the early arrivals are sub-adult, followed later by adult birds which have assumed most of the winter plumage, though the change is often gradual and delayed. This bird is one of the common Sandpipers and is found on all the lakes, swamps, rivers, temporary waterpans and on upland streams. It is also met with on the creeks along the coast. Smaller in size than the Green Sandpiper, this bird differs in having a more speckled plumage and a more barred tail. Its general habits are very similar, and there is a marked preference for muddy pools and mud-flats. When flushed, it utters its alarm note, a thrice repeated " giif."

One often meets with these birds in quite small open water amongst papyrus beds, often in company with Painted Snipe. They are also addicted to shallow night-soil pits on the plains beyond Nairobi; here, as already indicated under the section dealing with Snipe, dipterous larvae abound, and doubtless are the attraction.

The food is mostly confined to insects in various forms, small crustacea, mollusca, and some spiders.

The northward movement takes place in the middle of April, but here also one may note the species throughout all the months of the year. Several birds are always to be noted on Lakes Nakuru and Naivasha, but they do not nest.

TRINGA NEBULARIA, Gunn.

GREENSHANK.

Ref. : Gunnerus, Leem. Besk. Finm. Lapp., 1767.

Type locality : Norway.

DISTRIBUTION :

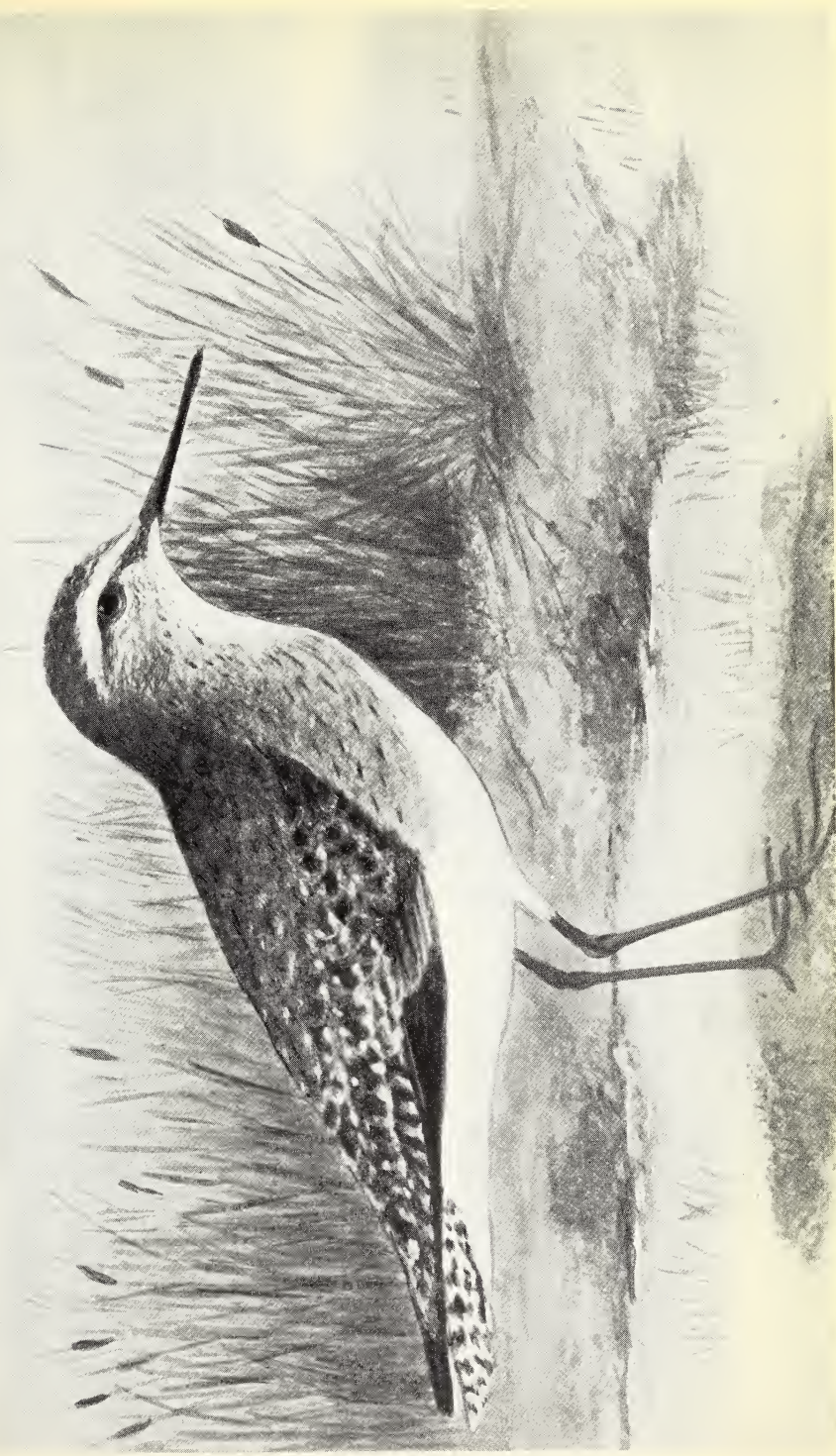
Breeds in the northern parts of Europe and Asia and spends the winter in the southern countries, including Africa.

DESCRIPTION : (Plate 23)

Male and female adult, winter : Forehead mostly white with black and white speckling starting at the root of the bill and widening out over the crown to nape and hind neck; lores white with a narrow speckled streak from nostril to eye; cheeks white; ear-coverts streaked black and white; throat and fore-neck white as also all underside; sides of breast with sepia shaft streak and wavy submarginal lines; mantle, scapulars and long inner secondaries ashy-grey-brown with sepia shaft streak and subterminal dark bar and pale edges, the long scapulars and long secondaries with sepia and whitish notching; back, rump, and upper tail-coverts white, longest ones slightly barred; tail : central pair ashy with sepia bar and irregular wavy submarginal line,







EUROPEAN WOOD-SANDPIPER. (*Tringa glareola*, Linn.)

tip white, remainder white with diminishing amount of sepia barring to outer ones which are marked only on the outer web; each has a subterminal wavy bar and white tip. Wings: primaries black-brown paler on inner web, second primary with white shaft; secondaries more ashy-brown narrowly edged white and white tipped, inner webs mottled; primary coverts ashy-grey-brown; median and greater coverts white edged and tipped, with dark shafts and dark submarginal bar; lesser coverts ashy-grey with whitish tips and edges, and dark shafts. Under wing-coverts white with wavy line, axillaries white or with slight line.

Summer: The change takes place in January and continues up to the time of leaving for the north. Birds are therefore not in full dress before leaving. The difference between this and winter dress is mostly apparent on the upper surface. The top of the head, neck (hinder and side) becomes striped black and white, the sides of the upper breast has wavy sepia to black bars and black spots, the barring extending to the flanks; and the shaft streak is blackish; the mantle, scapulars and long inner secondaries have dark sepia centres, wavy submarginal lines and notched with dark sepia and white edged, the long scapulars and long secondaries have the black notching most marked. The wings as in winter except that the greater and median coverts become like the inner scapulars. Wings: 185-200 mm. Bill, upcurved olive-grey, 50-58 mm. Legs olive-green.

Sub-adult: Like winter but dark markings more brownish sepia; and light marks tinged with buffy, less white. Primaries and secondaries tipped buffy, coverts tipped buffy.

HABITS:

This is the largest of the Sandpipers and cannot be mistaken. The size and upcurved bill is distinctive, as also the white back and rump plainly visible as the bird is flushed. As they rise they utter a loud thrice-repeated "tchew," and circling round will return to the original pool. With the advent of autumn these birds appear in small numbers and scatter over the various waters of Kenya and Uganda, not only on lakes but also rivers and streams and temporary pans and artificial dams. The earliest arrivals have been noted in September, and on the larger lakes their numbers increase up to October. They remain until the spring, leaving toward the end of April or beginning of May. A few birds may be noted during June to August, mostly immature.

Away from large sheets of water, single specimens may be seen on any odd temporary marsh or waterpool, sometimes many miles from the nearest permanent water. The food is taken as the bird walks in the shallows, and consists of insects and their larvae (dipterous, hymenopterous and odonata), small mollusca and crustacea. Here also one finds an association between cattle watering places and feeding

grounds for these birds. Not only is food abundant in such places but the water and its approaches are often laid bare and numerous puddles are formed. The mud flats of Lake Nakuru always prove an attraction and in my experience the greatest numbers are to be found there. Not confined to inland waters, these birds are also to be met with on the coast of Kenya, along the sea front, but mostly on the tidal creeks amongst the mangroves. They are far less wary than the Green Sandpiper and will allow of a reasonable approach.

Genus *LIMOSA*.

LIMOSA LIMOSA LIMOSA, Linn. BLACK-TAILED GODWIT.

Ref. : Linnaeus, Syst. Nat., 1758.

Type locality : Sweden.

DISTRIBUTION :

In summer, breeds in the northern parts of Europe migrating southward for the winter, reaching the eastern side of Africa as far as Natal.

DESCRIPTION : (Not figured)

Male and female, winter : Top of head to nape and upper mantle grey-brown, tipped paler ; mantle and scapulars grey-brown with darker shaft streak ; lores whitish with an ill-defined supercillium, and a dark loreal streak ; cheeks buffy, throat, fore-neck, breast and sides light grey-brown, the last with pale tips ; rest of lower surface to vent, white ; back and rump dark sepia ; upper tail-coverts white, long ones with black bar tipped white. Tail : white with a broad black bar widest at central pair and gradually diminishing to outermost, most with white tips, central pair tipped buffy. Primaries dark sepia, paler on inner webs inclining to white at bases ; secondaries similar with white tips and increasing white on outer webs toward inner ones ; greater coverts sepia with whitish tips ; median coverts more grey-brown with dark shafts and narrow white margins, lesser coverts darker with narrow paler edges.

Summer : No examples in this stage have been recorded from East Africa. The general change is on the upper side which becomes more boldly streaked and the feathers are bordered with pink-buff to cinnamon. The flanks are also washed with buffy-pink.

HABITS :

Very little is known of this bird within the countries dealt with in this paper. Only two records are available to my knowledge, one on the Juba River towards Kismayu and the other at the mouth of the Tana River. It has not been recorded from inland waters. Its dis-

tinctively marked tail, long upcurved bill, and general plumage should render it easily recognisable.

Bill, dark brown at tip, shading to lighter brown and pinkish at base, 90-125 mm.; females longer. Legs and feet dark grey-green: eyes brown. Wings 215-240 mm.; females larger than males.

LIMOSA LAPPONICA, Linn.

BAR-TAIL GODWIT.

Ref. Linnaeus, Syst. Nat., 1758.

Type locality: Lapland.

DISTRIBUTION: (Not figured)

Breeds in Northern Europe and Asia, migrating south in winter; recorded from Seychelles and Somali coast.

NOTE.—This species is included here as it is possible that stray birds may find their way along the coast of Kenya. It has actually been recorded as observed but not secured. The strongly barred tail and general build, very similar to the Black-tailed Godwit, make identification reasonably safe.

Genus *NUMENIUS*

NUMENIUS ARQUATA ARQUATA, Linn. EUROPEAN CURLEW

Ref.: Linnaeus, Syst. Nat., 1758.

Type locality: Sweden.

NUMENIUS ARQUATA LINEATUS, Cuv. EASTERN CURLEW.

Ref.: Cuvier, Regne Anim., 1829.

Type locality: India.

DISTRIBUTION:

Throughout the greater portion of Europe, migrating south and reaching the Cape, during the winter. The Eastern race breeds in the north of Siberia and Asia; south to Africa in winter.

DESCRIPTION: (Plate 24)

Male and female adults, winter. Crown sepia-black and buffy streaked, paler on the forehead; chin and throat white; nape and hind neck as crown but streaking narrower; sides and front of neck, upper breast white with buffy tinge and streaked with sepia. Mantle and scapulars with rather pointed feathers dark sepia-black with grey-brown to buffy margins, the long scapulars and long inner secondaries with dark oblique barring and buffy to white notching mostly on the outer webs. Back and rump white, lower rump streaked sepia and upper tail-coverts white with sepia central streak and sepia barring in-

complete; tail white with sepia barring strongest on outer webs, central pairs shaded buffy-grey between the bars, tips white. Abdomen and flanks white, the latter with sepia shaft streaks; vent and under tail-coverts white with dark shafts, near the ends. Wings. primaries black, with distal half of inner web paler, barred or mottled with sepia, inner ones from 7th notched white on the outer webs; secondaries blackish-brown with white marginal notches and white tips; primary coverts black-brown white tipped; greater coverts sepia with wide white notches, almost bars; median and lesser coverts like scapulars and mantle but with more sepia centres; under wing-coverts white with some barring, so also the axillaries. In the Eastern race, the underwing coverts and axillaries are white, the back and rump white, and the streaking on the breast narrower, while the general tone of the upper surface is paler.

Summer: Very like the winter plumage; the outstanding difference is in the margins of the feathers on the upper surface from the crown to the back; the centres are more strongly dark while the edgings and margins are cinnamon-buffy; the underside is also tinged with buffy. Bill, blackish at tip, shading to brown and yellowish at the base of the lower: 100-150 mm., females larger. Wings, 280-320 mm., females run larger than males; eyes brown; legs and feet grey-green.

HABITS:

We have already noticed the difference in the plumages between the Western and Eastern races of the Curlew. Both frequent the coastal beaches and creeks of Kenya, and a few are recorded from inland waters such as the larger lakes of both Uganda and Kenya, but particularly Lake Rudolf.

The large size, distinctive build and long downward-curved bill render this bird easily recognisable. The only possible confusion might be with the Whimbrel which is much of the same shape, but considerably smaller.

These birds are most in evidence when the tide has receded and laid bare the stretches of reef and banks along the sea-shore; when the tide is high they flight up the creeks seemingly preferring the shelter of these to the open sea front.

They call as they flight along the shore at dusk or even late into the night; the whistling note is similar to that heard at home. When roosting they congregate in flocks on some particular sheltered cove or reach of shore, but at feeding time they disperse in small parties or in ones or twos. They are very wary at such times and just keep out of range, by walking along or taking short flights. Their periods of rest coincide with high water for most of the feeding is done in the shallows along the reefs and in the pools left by the ebbing tide along







the creeks. The food consists largely of marine worms and slugs, crustacea and mollusca, larvae of various kinds, and certain sea-weeds.

Though many examples are noted throughout the year both along the coast and on inland waters, the species does not breed here.

The Curlews arrive in fair numbers toward the end of October all along the coast, and a few odd birds make their appearance on inland waters, such as Lake Rudolf, in September. They are noted in greatest numbers just before the northward move, toward the end of March, and they are still numerous up to the middle of April, but many non-breeders remain on throughout the summer months.

NUMENIUS PHAEOPUS PHAEOPUS, Linn.

EUROPEAN
WHIMBREL.

Ref. : Linnaeus Syst. Nat., 1758.

Type locality : Sweden.

NUMENIUS PHAEOPUS ALBOAXILLARIS, Lowe.

EAST AFRICAN WHIMBREL.

Ref. : Lowe, B.B.O.C., 1921.

Type locality : Inhambane, P.E.A.

DISTRIBUTION :

The European Whimbrel breeds in Iceland east to Northern Siberia, and migrates southward for the winter, reaching Eastern Africa to as far as the Cape.

DESCRIPTION : (Plate 25)

Like a small edition of the Curlew, but darker. Top of head from base of bill to nape sepia, with a central buffy streak irregularly marked ; a superciliary streak from the nostrils to the nape ; lores sepia, eyelids white, ear-coverts streaked white to buffy and sepia ; cheeks buffy mottled with sepia ; neck whitish to buffy narrowly streaked light sepia ; chest and flanks whitish with larger light sepia streaks centrally, expanding centrally and ending in a point on the shaft, those of the flanks running into bars ; rest of underside white, with some sepia spots on the under tail-coverts ; throat white ; mantle sepia, with slight buffy notches along edges ; scapulars similar but marginal notches more pronounced, those of the long scapulars more buffy ; long inner secondaries sepia with ashy-grey incomplete banding and white to buffy marginal notches ; primaries sepia to blackish, with inner webs paler basally and with white notching to bars ; inner primaries with white notching on the outer webs ; secondaries sepia with white tips, white notches to almost bars on both webs ; primary coverts sepia with white tips ; other coverts sepia with broad buffy to white notches and pale tips and margins, lesser coverts at bend rather darker and with less buffy to

white at margins. Axillaries white barred with sepia mostly on outer webs.

Wings 235-260 mm.; females larger than males. Bill 75-98 mm.; horn brown, darker at tip and yellowish at base of lower; eyes brown; legs and feet olive-grey.

The African race *ALBOAXILLARIS* differs from the nomotypical form in having the under wing-coverts and axillaries pure white. This appears to be a somewhat doubtful character and not very constant, many African specimens showing a variation from pure white to strong barring. It is said to breed on Mauritius but this requires confirmation.

HABITS :

The Whimbrel is like a small edition of the Curlew and in its general behaviour resembles that species. One can distinguish it in the field by its smaller size, darker back and head, the latter with a pale stripe down the centre.

Whereas the Curlew is more a bird of the coast line, the Whimbrel is more often recorded on inland waters. Thus on Lakes Nakuru, Naivasha, and Rudolf many specimens are noted; it has also been recorded on the lakes of Western Uganda and Lake Kioga.

The African race, however, is said to be limited to the coastal strip, but as already indicated, the status of this bird is not satisfactory.

The earliest record for any inland water is August 28th, but the bulk arrive in September, not in flocks, but driblets, doubtless spending much of their time along the Nile. They were noted in considerable numbers on the Sudan Nile in November and October.

They frequent the mud bank and areas of clear shore, feeding at and just below water level, and resting on the flats.

The food consists of aquatic insects and their larvae, small mollusca and crustacea, and seeds of water-weeds.

The Whimbrel is much less wary than the Curlew, and one is able to approach to within sufficient distance to obtain the bird with a small bore gun, or to make accurate observations without the aid of glasses.

I am not aware that eggs of the African race have been taken or described.

NOTES ON THE HYDROLOGY OF LAKE NAIVASHA.

By H. L. SIKES, C.B.E., B.A., B.E., M.INST.C.E., F.G.S.

The hydrological features of Lake Naivasha are not only of scientific interest but are also of some economic importance. A record of the fluctuations of lake level has been maintained with four short breaks since the end of 1908, readings being taken weekly. A bathymetrical survey was carried out in 1927 with sufficient precision to enable the volume of water and the area of the lake to be calculated approximately as the level varies. Evaporation meter readings were started in 1917, but, in the case of those prior to 1920, the method adopted is not regarded as sufficiently reliable to be of value; the records are incomplete for the years 1927 and 1928, but complete records exist for 14 years. The number of rain gauges in the drainage area of the lake, 1,203 square miles, is still regrettably small. Only six have been established and of these the longest record is from 1904. However, a number of gauges outside the drainage area, under climatic conditions which appear to correspond fairly well with one or other part of the drainage area, provide useful data for co-ordination and check. With the help of these a reasonably accurate knowledge of the rainfall on the drainage or catchment area and on Lake Naivasha itself is thought to have been achieved, though, in the case of a region where much of the rainfall is of the instability type, precision is impossible of attainment. Two of the gauges, situated within half a mile of one another, under apparently identical topographical and climatic conditions occasionally show pronounced divergence owing to local thunderstorms, which cause high precipitation on one, but not on the other.

The circumstance which is thought sufficient to justify deductions from records, provisional though they must necessarily be in some cases, is that from April 1st, 1935, to March 31st, 1936, the Public Works Department, in the course of hydrographic survey, maintained a continuous record of the flow to the lake of the Melawa (Morendat), Gilgil and Karatj Rivers which drain most of the catchment area of Lake Naivasha. By applying the percentage of the rainfall which was ascertained to have been discharged from areas presenting similar geological and topographical features to the remaining portion of the drainage area, where only short flood channels exist, a sufficiently accurate assessment of the whole surface discharge to the lake during that year is believed to have been obtained.

Lake Naivasha lies in long. $36^{\circ} 20' \text{ E.}$, lat. $0^{\circ} 45' \text{ S.}$ Since records were commenced, the elevation of its surface has varied from

6,217.70 feet above mean sea level on November 17th, 1917, to 6,194.66 on February 21st, 1936, a range of 23 feet. The volume of water in the lake has fluctuated from 68,400 million cubic feet (.464 cubic mile) to 22,700 million cubic feet (.154 cubic mile), and the superficial area from 2,390 million square feet (80.3 square miles) to 1,640 million square feet (58.8 square miles). Its fluctuations from 1909 to 1935 are shown in Plate I, fig. 1, and an outline of probabilities in respect of the major changes during preceding years is indicated by a dotted line. The greatest depth of the lake is found on the floor of an extinct crater, about half a square mile in area. Crescent Island and the adjacent island are parts of the wall of the crater. The depth of water within the crater has varied from about 80 feet in 1915 to 57 feet in February, 1936. Outside the Crescent Island crater, the maximum depth of the lake has fluctuated from about 45 feet in 1917 to 22 feet in February, 1936.

It is not intended to deal in this paper with the history of Lake Naivasha in Quaternary times. The results of the investigations of Dr. Erik Nilsson of the Swedish Geological Expedition are recorded in his "Quaternary Glaciations and Pluvial Lakes in British East Africa" (Stockholm, 1932) and no new light has been thrown on the geological history of the lake since his surveys. The evidence that the highest level of the lake was about 400 feet above present level during the Second Pluvial, extending over the Gilgil pass in continuity with the enlarged Nakuru—Elmenteita Lake, is not likely to be assailed as it accords with the conclusions of other observers. Dr. Nilsson found five other beaches, demarcating rest levels of the lake, between the maximum and present-day levels and considers also that the lake dried up completely during two arid periods subsequent to the Second Pluvial. Nor is it intended to deal with the geological features of the drainage area of the lake, except in so far as considerations of percolation from the lake bottom and run off from the drainage area are influenced by them. It may be mentioned, however, that excepting the ancient lake sediments consisting of silts, sands, and diatomites, which occupy only a very small percentage of the drainage area, the solid rocks are all volcanic in origin and are highly faulted by the meridional Rift Valley fractures. The lavas constitute a varied assemblage of soda-rhyolites and soda-trachytes, except in the Aberdare Range, a part of the western flank of which lies within the drainage area, where a different series, ranging from intermediate to basic, is found east of the early main fault of the Rift Valley. Lake Naivasha occupies a shallow pan in the lowest part of the cross section of the Rift Valley at the latitude of the lake, the drainage area rising above it to some 6,000 feet eastward and 4,000 feet westward. The volcanic rocks in its vicinity are the most recent of all. They exhibit sharply defined craters, tuff cones, fresh lavas and numerous steam vents. Meteorologically the drainage area is partly in the sub-arid and partly in the



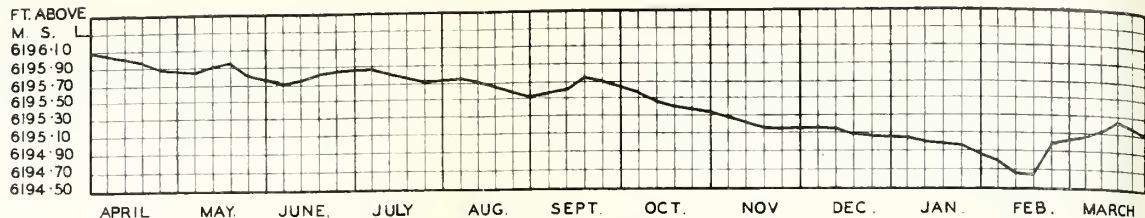


FIG.1. VARIATIONS OF LAKE LEVEL BETWEEN APRIL 1st.1935 AND MARCH 31st. 1936

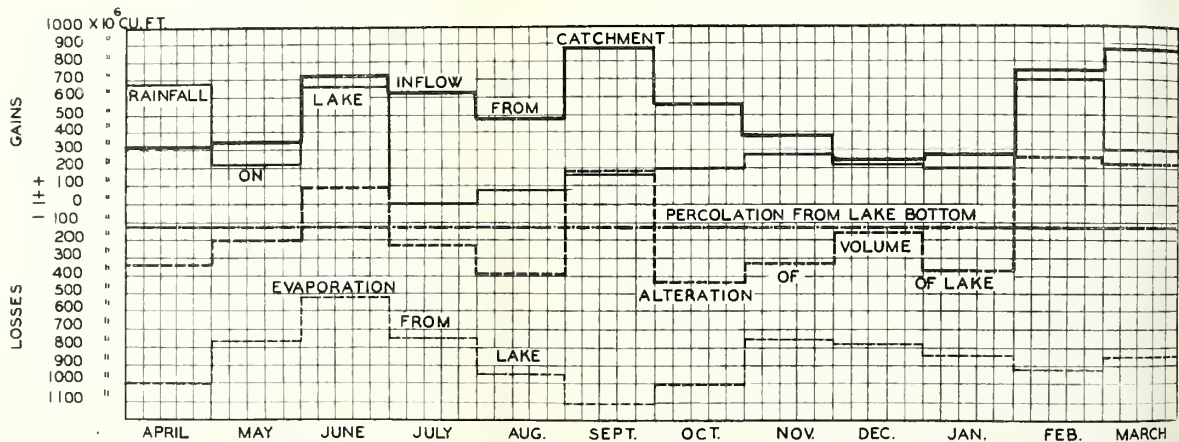
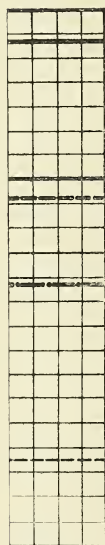


FIG.2. DIAGRAM SHOWING MONTHLY GAINS IN VOLUME OF LAKE FROM (1) INFLOW FROM CATCHMENT (2) RAINFALL ON LAKE (3) RISE IN LAKE LEVEL AND LOSSES FROM (1) EVAPORATION FROM LAKE (2) PERCOLATION FROM LAKE BOTTOM (3) FALL IN LAKE LEVEL DURING THE PERIOD APRIL 1st 1935 AND MARCH 31st 1936. TOTALS FOR THE YEAR: MEAN RAINFALL ON THE CATCHMENT AREA OF 33550 MILLION SQ. FEET OR 1203 SQUARE MILES:- 3.18 FEET OR 106675 MILLION CU. FEET. INFLOW INTO THE LAKE FROM THE CATCHMENT AREA:- 6496 MILLION CU. FEET A RUN-OFF OF 6.11% OF THE RAINFALL OR .194 FEET IN DEPTH ON THE CATCHMENT AREA. RAINFALL ON THE LAKE:- 2.23 FEET OR 3724 MILLION CU. FEET. EVAPORATION FROM LAKE:- 6.16 FEET OR 10287 MILLION CU. FEET. PERCOLATION FROM THE LAKE BOTTOM:- .92 FEET OR 1536 MILLION CU. FT. A MEAN FLOW OF 49 CU. SEC. OR .81 CU. SEC. PER SQ. MILE. MEAN AREA OF LAKE SURFACE:- 59.9 SQ. MILES. REDUCTION OF VOLUME OF WATER IN LAKE:- .96 FEET OR 1603 MILLION CU. FEET.



MARCH



MARCH

S.

FEET
ABOVE
MEAN
SEA
LEVEL

623

622

621

620

619

MEAN
FROM
MEAN
DRAINAGE
MEAN
LAKES

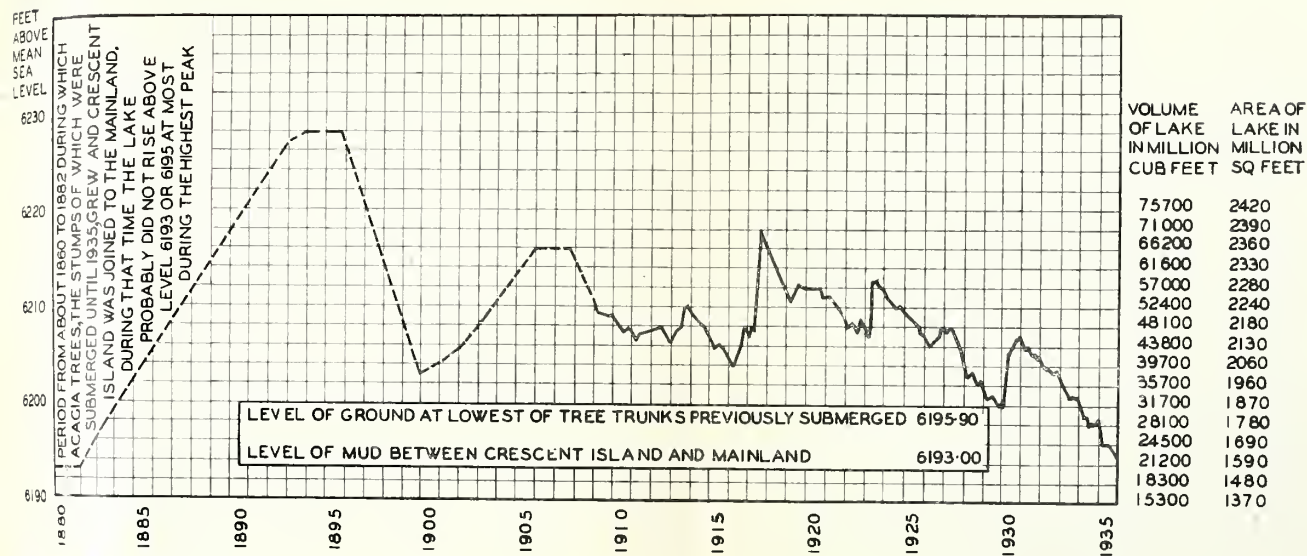


FIG.1 VARIATIONS OF LEVEL OF LAKE NAIVASHA

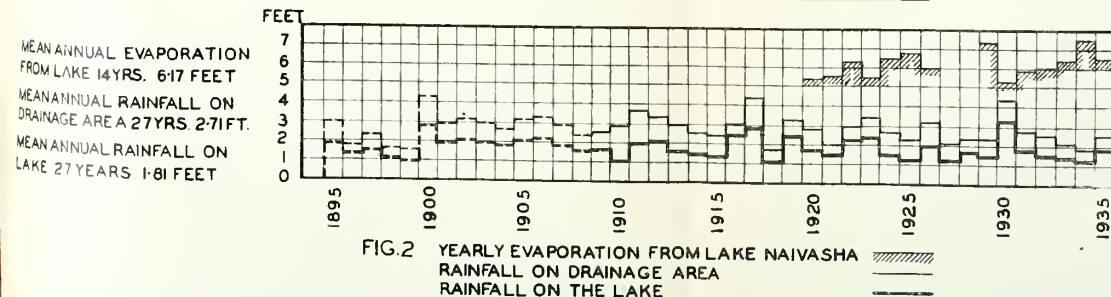


FIG.2 YEARLY EVAPORATION FROM LAKE NAIVASHA

sub-humid zone, the former predominating; the 40 inch isohyet crosses it. The rainfall decreases rapidly from the Aberdare Range and Kinangop Plateau westward across the lake. The average annual rainfall is assessed at 32.52 inches or 2.71 feet.

Plate II and the following schedule set forth the results obtained from the observations during the period April 1st, 1935, to March 31st, 1936.

DISCHARGE INTO LAKE NAIVASHA FROM ITS DRAINAGE AREA.

| Catchment. | Area of catchment in square miles. | Rainfall in feet depth. | Rainfall in million cubic feet. | Discharge to lake in million cubic feet. | Discharge expressed as average depth over catchment in feet. | Discharge expressed as percentage of rainfall. | Maximum rate of discharge cuasecs. | Minimum rate of discharge cuasecs. | Mean rate of discharge cuasecs. |
|-----------------------------|---------------------------------------|-------------------------|------------------------------------|---|--|--|---------------------------------------|---------------------------------------|------------------------------------|
| Melawa ... | 618 | 3.80 | 65,470 | 5,004 | .291 | 7.65 | 745 | 28 | 158 |
| Gilgil ... | 108 | 3.43 | 10,327 | 438 | .146 | 4.25 | 236 | 1 | 14 |
| Karati ... | 52 | 3.05 | 4,453 | 121 | .086 | 2.81 | 189 | 0 | 4 |
| Remainder ... | 425 | 2.23 | 26,425 | 933 | .081 | 3.63* | — | — | — |
| Totals for drainage area | 1,203 | | 106,675 | 6,496 | | | | | |
| Means ... | | 3.18 | | | .194 | 6.10 | | | |

* Assessed as average of percentages of Gilgil and Karati catchments.

The higher percentage of the rainfall on the catchment of the Melawa River which is discharged, in comparison with the others, is explainable by the occurrence, over greater portions of the area, of argillaceous soil. The presence of forests at the headwaters of the river and its tributaries must also have an important influence on the preservation of a perennial flow by reducing soil evaporation. The mean discharge percentage of 6.10% from the drainage area of the lake is low. The year under review has followed four years of sub-normal rainfall, of which the year immediately preceding it had the lowest record. In consequence the soil and rocks would have been severely dried out. The ground water level would be below the bottoms of the valleys. At the surface, in the exposed parts, there was probably little moisture left, except the water of imbibition, after months of drought. If one is justified in assuming that the leakage of water from the lake is constant at 1,536 million cubic feet per annum (the figure arrived at for the year April 1st, 1935, to March 31st, 1936,

according to the method reviewed later in this paper) it can be deduced as probable that the average annual discharge from the drainage area of the lake to the lake is of the order of 9% of the rainfall and that in 1930, a year of high rainfall, it was about 13%. The effect which diversions of water by riparian holders of land may have on the regimen of the lake is indeterminate, but it is thought to be so small that it may be neglected. Authorised diversions from streams in the drainage area amount, in the aggregate, to 1.788 cusecs. It is impossible to ascertain to what extent this is exceeded. The excess may well be several times that flow during dry weather conditions. On the other hand, not only are many of the diversions intermittent, but much of the water must get back to the streams. From these considerations, it is regarded as reasonable to assess the net annual loss to the lake from this cause as the aggregate of the authorised diversions, assumed to be flowing continuously throughout the year. This is equivalent to a loss of 48 million cubic feet, or less than 1% of the discharge from the catchment area.

Sub-surface inflow to the lake is indeterminable, but requires consideration in respect of probability. The formations in the vicinity of the lake are the Quaternary lacustrine sediments and volcanic rocks. The former predominate on the north and east sides of the lake and the latter on the south and west sides. Usually the sediments have gentle surface gradients towards the lake, while the volcanic rocks are steep and extend as promontories into the lake. The mechanical constitution of the sediments is such that they are capable of transmitting water between the grains as well as being moderately absorptive. The transmission rate has not been examined, but the absorptive capacity of a fair average specimen was found to be 32% by weight from complete dryness. Of this, the water of imbibition amounted to 14.5%. Subterranean caves and channels, eroded by water and perhaps originating in ant bear holes, also exist. The volcanic rocks are very varied in mechanical constitution, but the bulk of them would transmit water readily through anastomosing joint cracks and crevices which abound in the recent lavas. While boring for water in similar rocks in other parts of the Rift Valley, the water supplied to the drilling bit was found to soak away very rapidly. Sometimes the rocks are cavernous. That this may extend to a considerable depth is shown by the occurrence of a cavern 2 feet deep in a borehole in the Kedong Valley in rhyolitic lava at a depth of over 700 feet. From observations on two wells in Naivasha township it appears that the level of the ground water in the sediments adjacent to the lake is ordinarily approximately coincident with lake level and fluctuates with it, though there is some lag. When the lake level is rising rapidly there is a slight gradient from the lake to the water level in the wells. The writer is not aware of any wells or boreholes having been sunk near the lake through the lava to the ground water, but the level of the water in Sonachi crater about $1\frac{1}{2}$

miles from the west shore also appears to be at lake level and to vary with it, though this has not been ascertained by precise levelling. It would seem therefore that the ground water level is preserved at lake level, both in the sediments and volcanic rocks, to an unknown distance from the lake shore. The levels of ground water in the lower parts of the Rift Valley (at those places where a water table, either perched or otherwise, occurs), as determined where boring for water has been carried out to some depth, indicate that, if Lake Naivasha did not exist as a body of water (or, in other words, if the area occupied by it had no perennial streams discharging into it) the level of the ground water would be likely to lie between 200 and 700 feet in depth. It seems to the writer to be most probable that the hydrostatic equilibrium of the ground water with the lake extends to no great distance inland from the shore of the lake and then dips. The lake surface and ground water surface would, in fact, take the shape of an inverted dish. It is thought that, under these circumstances, such seepage as there may be to the lake would only occur during, or shortly after, rain in the immediate vicinity of the lake. Such seepage water would be immediately subjected to transpiration of the rank vegetation growing both above and below the lake margin along most of its perimeter as well as to intense evaporation from the heated shallow water near the lake shore. From these considerations it is thought that sub-surface percolation to the lake may be disregarded as a contribution to inflow.

In the evaluation of the hydrological factors affecting a lake, reservoir, or river, the determination of the evaporation from its surface is often the most uncertain. There is no generally accepted standardisation of evaporation meter and the factors which influence correlation between the readings of any particular kind of meter and the evaporation from an adjacent large sheet of water are complex and not readily reducible to a formula. Evaporation is mainly dependent on the difference between the tensional force of the vapour due to the temperature of the evaporating surface and that of the vapour already in the atmosphere, being greatest when there is the greatest difference between the temperature of the evaporating surface and the dewpoint; but it is influenced by the breaking up of the surface by wind, transpiration of vegetation in the water and other circumstances. The type of meter adopted at Naivasha consists of a concrete tank three feet square and two feet six inches in depth with a closed overflow chamber and a rain gauge alongside. The evaporation is calculated from measurement of the water required to fill the tank to overflow level, the rainfall and the overflow (if any). In Egypt, the evaporation from an extended water surface is calculated as .88 of the measured evaporation from a tank one metre cube in capacity (The Nile Basin, Hurst & Phillips, Vol. 1, p. 60, Physical Department of Min. of Pub. Works, Cairo, 1931). In the case of Lake Naivasha, however, strong drying winds frequently occur, replacing the air in proximity with the water

and breaking up the water surface; much of the lake is very shallow and becomes highly heated during sunshine; while considerable areas adjacent to the shore are occupied by reeds, papyrus, and other water vegetation. These circumstances cause higher losses from the lake, in relation to those from an evaporation meter, than is usual. Moreover the surface temperature of the water, even in the deep portions of the lake, is sometimes slightly higher than that in the evaporation tank. On March 22nd, 1936, a hot still day following similar ones, it was found by the writer that the midday temperature of the water in the evaporation tank was 24°C ., while the surface temperature of the deep water between the horns of Crescent Island was 25°C . At the same time the temperature of the shallow water close to the shore amongst water weeds was 31°C . In the early morning the temperature of the shallow water had sunk to 17°C . On June 6th, 1936, a cool day with frequent sunshine and a moderate wind, the early afternoon temperature of the air was 20°C ., the tank water 22°C ., deep water 21°C ., and shallow water 23°C . During the following early morning when the air temperature was 13°C ., that of deep water had sunk to 20°C . and shallow water to 18°C . For these reasons it is considered by the writer that, under the circumstances prevailing at Lake Naivasha, it is more correct to assess the average evaporation from the lake surface as equivalent to the readings of the meter. It has, in fact, been held by Prof. Carpenter, State Agricultural College, Colorado, that the evaporation from four of the lakes in that State is slightly greater than that recorded from evaporation tanks of three feet cube.

The total evaporation from the evaporation tank during the year April 1st, 1935, to March 31st, 1936, was 6.16 feet depth and, taking that from the lake as equivalent, the volume lost by the lake amounted to 10,287 million cubic feet. The mean annual evaporation for 14 years is 6.17 feet, with maximum and minimum of 7.48 feet and 5.13 feet. Dr. Hurst of the Physical Department of the Egyptian Public Works Ministry has regarded the mean annual evaporation from Lake Victoria as 1,310 mm. (4.30 feet) (The Lake Plateau Basin of the Nile, Cairo, 1925). Gillman has adopted Theeuwes' figure of 1,350 mm. (4.43 feet) for Lake Tanganyika (The Hydrology of Lake Tanganyika, Dar es Salaam, 1933). At those two lakes, however, the mean atmospheric humidity is likely to be much higher than at Lake Naivasha and the average water temperature during sunshine may even be lower, on account of the ratio of shallow water to deep water being so much less than in the case of Lake Naivasha. Moreover, it would appear that the estimates of evaporation for Lakes Victoria and Tanganyika are not based on actual measurements. With regard to the evaporation from Lake Victoria Drs. Hurst and Philips observe (The Nile Basin, Vol. 1, p. 61): "The annual total is computed from rainfall + runoff —outflow over Ripon Falls. There are uncertainties about the runoff

which is estimated from scanty data." In some hot arid countries, where the atmospheric humidity is low and the water temperature high, annual evaporation up to 12 feet has been recorded. On the other hand, in cold humid countries, the annual evaporation is less than the annual rainfall, as in England.

The mean rainfall on the lake during the year under review is computed at 2.23 feet in depth or 3,724 million cubic feet. The level of the lake surface went down from 6,196.10 feet above mean sea level on April 1st, 1935, to 6,195.14 feet on March 31st, 1936, a drop of .96 feet, or reduction of volume of 1,603 million cubic feet. Applying the formula: evaporation + percolation from the lake = inflow + rainfall on the lake + reduction of volume of the lake, it is found that percolation from the lake (expressed in millions of cubic feet) = $6,496 + 3,724 + 1,603 - 10,287$ or 1,536 million cubic feet, or a uniform depth of .92 feet over the lake bottom of 1,670 million square feet mean area during the year. This loss amounts to a sub-surface flow from the lake at an average rate of 49 cusecs, or .81 cusecs per square mile. The loss by percolation might, however, be more suitably spread over the area adjacent to the lake, at which the ground water is in hydrostatic equilibrium with that of the lake (if this were determinable), as well as the area of the lake itself. The authorised diversions by pumping from the lake for short distances from the shore by riparian landowners are 2.011 cusecs in the aggregate. It is thought that these diversions of water would have no great influence because, not only is the pumping intermittent, but much of the water would percolate back to the ground water at lake level. The conditions at Lake Naivasha, in respect of loss by percolation, appear to be not dissimilar from those prevailing at large reservoirs in strata of fair permeability and where the natural water table is at a lower level. Losses by percolation (or absorption) from reservoirs in Rajputana have been stated by Culcheth to be 3.62 feet depth per annum; and in the case of the Sagar Reservoir, the loss from percolation and absorption is stated as having ranged from 1.56 feet to 1.83 feet per annum. As already mentioned, considerations of the depth at which ground water has been found by boring in the most recently formed parts of the Rift Valley lead to the view that if it were not for the perennial streams, the ground water at Lake Naivasha would be at a considerable depth. In other words, the lake surface and adjacent ground water form a water table analogous to that of an artificial reservoir in permeable strata. It is a matter of conjecture what happens to continuous percolation at the rate of 49 cusecs, a flow which, if concentrated, would be much the same as the normal flow of the Thika River above its confluence with the Chania River at the Blue Posts Hotel. It is clear that, in common with much of the portion of the rainfall on the Rift Valley which percolates beyond the influence of soil evaporation and transpiration, it does not re-emerge as springs. The rainfall and other conditions in the

Rift Valley are such that, on hydrological grounds, one would expect some re-emergence if there were no cause inhibiting it. Nor does escape laterally through the boundary walls of the Rift Valley appear possible on geological grounds and there is no hydrographical support for such a theory. The springs at Lakes Magadi and Enegarami, amounting in the aggregate to 28 cusecs (Coates, 1908), may possibly account for some of the percolation in the southern part of the Rift Valley, though the origin of these springs has been regarded as more likely to be magmatic than meteoric, on chemical grounds. In a brochure entitled "The Underground Water Resources of Kenya Colony" (Sikes, London, 1934, page 24), the writer has advanced the view that much of the portion of the rainfall on the Rift Valley which percolates deeply is carried to the surface again by meeting upward discharges of vapour of magmatic origin. Boring for water has shown the temperature-depth gradient to be very steep sometimes, and at two boreholes steam was encountered. The region in the neighbourhood of Lake Naivasha has many steam vents and any water percolating laterally would be likely to meet high temperatures where the water would be vaporised and ascend, either through visible vents, or to within reach of soil evaporation.

Plate I, fig. 1, shows, plotted to a small scale, the recorded levels of the lake from 1909. An outline of probabilities regarding the major lake fluctuations during the preceding few decades is shown by dotted lines. Plate II, fig. 2, shows the evaporation records from 1920, except for a break in 1927 and 1928, the records for those years being incomplete. It also shows the mean rainfall on the drainage area and the lake from 1909, to the extent that the co-ordination of records permits of precision of determination. Probabilities regarding the mean yearly rainfall from 1895 to 1908 are indicated as dotted lines. These latter are, however, only obtained by deduction from the records of Fort Hall and Machakos.

An examination of the diagram will show the close correlation between rainfall and evaporation. During years of low rainfall, the number of hours sunshine in the year would ordinarily be higher and the mean humidity lower than normal, resulting in greater loss by evaporation. In years of high rainfall the converse would prevail. The level of the lake usually responds fairly rapidly to rainfall on the drainage area, but there sometimes seems to be a considerable lag if the ground is very dry and the rainfall spasmodic. A subsidiary peak in the lake level record sometimes occurs in dry months succeeding rain after a portion of the rainfall which sinks has had time to feed the permanent streams by seepage at stream level. The extent to which lake level responds to a year of high rainfall and low evaporation depends very greatly on the rainfall of the preceding year or years. If the rainfall of the preceding year has been above the mean, the soil

and rock within the zone of evaporation will have been well soaked and a higher runoff is experienced during the ensuing year of abnormally high rainfall. The mean rainfall of 1917 was practically the same as that of 1930, namely 61% above the mean, but the former was preceded by a year when the rainfall was 12% above the mean and the latter by one having a rainfall 15% below the mean. The rise during 1917 was much higher in consequence than that in 1930. A series of dry years has a cumulative influence in the same way. As the lake drops in level, the area exposed to evaporation becomes smaller, but this is probably compensated for by the greater intensity of evaporation on account of the proportion of shallow water to deep water being increased. Since the peak of 1930, the rainfall of 1931 was average and the four subsequent years were below the mean. The fall of lake level, since the peak of 1930, has been 12.20 feet, equivalent to a reduction of lake volume from 46,500 million cubic feet to 22,700 million cubic feet, or 51%, while the area of the lake has been reduced in the same period from 2,160 million square feet to 1,640 million square feet, or 24%.

The data regarding variation of the pH and alkalinity values of the water with lake volume are not as extensive as one would wish. These values would vary according to the part of the lake from which specimens of water are taken. The only determinations available to the writer, from which deductions are possible, are from a sample taken by Miss Jenkin of the Fresh Water Biological Laboratory, Ambleside, on July 2nd, 1929, at the surface of the deep water off Crescent Island (Reports of the Percy Sladen Expedition to some Rift Valley Lakes in 1929, *Annals and Magazine of Nat. Hist.*, Ser. 10, Vol. IX, p. 543; June, 1932) and one taken at the same locality by the writer on March 21st, 1936. The determinations from the latter were made by courtesy of Mr. V. A. Beckley, M.A., Scott Agricultural Laboratory, Nairobi. On July 2nd, 1929, when the first sample was taken, the lake volume was 33,000 million cubic feet and pH was determined as 8.3 and alkali (as one-tenth normality) .039. On March 21st, 1936, the lake volume was 23,500 million cubic feet and pH was determined as 9.16 and alkali .0494. The reduction of lake volume between the two determinations was 30% and the increase of alkalinity 26.7%. The increase in pH value is higher than one would expect and may be due to difference in method of determination. Scanty as the information is, it lends support to the view that the alkalinity of the lake varies approximately with its volume and that leakage has no great effect on it. The view that the comparative freshness of the lake is due to its having dried up in recent geological times has been expressed by Nilsson (Quaternary Glaciations and Pluvial Lakes in British East Africa, p. 73) and, in the view of the writer, the evidence in favour of it is much more cogent than the theory that it is due to leakage.

The evidence that lake level did not rise above 6,193 feet above mean sea level (or 6,195 at most), as indicated on Plate I, fig. 1, for a long period, which cannot have been less than 20 years and was probably greater, is strong. Moreover it is probable that water level did occasionally reach to, or near to, that level at peaks during this low lake period, which seems to have terminated in 1882, when the lake started to rise. The lowest level of the lake since records started is 6,194.76, on February 25th, 1936. The evidence regarding the length of the period of low lake level rests on the occurrence of a number of erect stumps of large acacia trees (*Acacia xanthophloea*) on the south shore of the lake. The base of the lowest tree is at level 6,195.90 and lake level had receded to it in April, 1935. A section of this stump was cut by the writer a couple of feet above ground level. Only the heartwood now remains. The circumference is 7.67 feet, the average diameter being 2.44 feet. The writer is advised by Mr. Gardner, Conservator of Forests, that the minimum period of life of the tree could not have been less than 20 years and is likely to have been greater. It is considered that the tree would have been killed if the lake level (and consequently the ground water under the tree) had risen substantially above its roots—or at most to just below ground level at the base of the tree. It is thought, however, that peak rises must sometimes have reached that level, or near it; for otherwise other large trees would have grown below it at this or other parts of the then-existing lake shore. There are in fact a few small tree stumps below that level and these had time to grow between peaks.

Very old Masaj of the Purko clan, now residing near Narok, recall that it was customary to drive cattle to Crescent Island for grazing when they were boys and that the island was then connected with the mainland. The level of the mud is 6,193 feet and, in view of its consistency, it would scarcely be possible to drive cattle across as a regular practice, unless the lake were at least six inches lower, or 6,192.50. The writer understands, however, that during low lake level at the end of 1935 and the beginning of 1936 some cattle were, in fact, driven across, though they had to swim for part of the way. By courtesy of Major Buxton, District Commissioner, Narok, the writer had an opportunity of hearing information from Masikonde, until recently Chief of the Purko Clan. Masikonde appears to be about 80 years of age. He is confined to his hut but is very clear-headed. His father's village was on the mainland opposite Crescent Island and he himself had accompanied cattle to the island while a boy. He was a moran when the first European arrived at Naivasha. He remembered that year as it was the one during which he had gone to live at Elmenteita. This European would be G. A. Fischer in June, 1883. Masikonde stated that the lake had then started to rise, but it was still possible to get across to Crescent Island. It would appear that, when James Thomson visited the lake at the end of September, 1883,

Crescent Island must have been still connected with the mainland (though papyrus or reeds may have been growing in a foot, or so, of water), for in describing the lake (Through Masai Land, p. 199) he makes no mention of Crescent Island and states: "There are three small islands grouped in its centre, though possibly they may simply be beds of papyrus rising from a very shallow part." It seems more likely that these were floating islands of papyrus which are not infrequent when the lake is rising.

When Teleki and von Höhnelt visited the lake in August, 1888, it is clear that the level was already high. Crescent Island and the two adjacent islands were separated from themselves and from the mainland (Discovery of Lakes Rudolph and Stephanie, Vol. 2, p. 295). The lake was very high during Gregory's visit in 1893. Hobley, describing his journey from the coast to Uganda in 1894 (Kenya from Chartered Company to Crown Colony, p. 79), records: ". . . the lake was so high that we were unable to pass between the reed-beds and the cliff, where the railway now runs, so we clambered over the bluff. . . ." From this description and other information as well as examination of the levels, the writer is of the opinion that lake level cannot have been less than 6,228 feet above sea level—that is about three feet below present rail level at the point—and may well have been a few feet higher. It probably remained high in 1895 as the rainfall at Machakos in that year was well above normal. There then followed four years of severe drought, culminating in the "famine years" of 1898 and 1899. During this period the lake must have dropped rapidly until 1900. The Railway Survey of 1898 shows that the lake level, on September 14th, 1898, was 6,214.72 and, on November 19th, 6,214.56. The writer knows of no determination of level in 1900 but the lake is known to have been very low in 1899 and 1900. The heavy rainfall of 1900, followed by several years of rainfall above the mean, caused the lake to rise to a peak in 1906 and 1907. Continuous records were commenced at the end of 1908, when the level stood at 6,210.90.

Evidence in favour of the fluctuations of level of the larger lakes of the Rift Valley with the 11 year sunspot cycle has been referred to by Brooks in the case of Lakes Victoria and Albert (*Journ. E.A. & U. Nat. Hist. Soc.*, Vol. 22, p. 47, 1925), by Dixey in the case of Lake Nyasa (*Nature*, 1st November, 1924), and by Gillman for Lake Tanganyika (Hydrology of Lake Tanganyika, Bull. No. 5, Geol. Surv. Tanganyika Terr., 1933). For Lake Naivasha, the peaks of 1894-95, 1906-7, and 1917 correspond almost exactly with maximum sunspot activity; that of 1930 is a year out, the maximum having been in 1929. The years 1927 and 1928, when the lake was falling, were, however, also years of high sunspot numbers. Although the year 1900 was a year of low sunspot activity and corresponds with low lake level, the

years 1913 and 1923 show peaks in lake level when sunspot numbers were low. Correspondence between lake levels and sunspots does not appear to be very strong in the case of Lake Naivasha, but there may well be correlation, which is influenced by other factors as well. The time during which the levels of Lake Naivasha are known is too short for deductions regarding the applicability of long-period cycles. The Brückner 35 year cycle may possibly have some significance as far as Lake Naivasha is concerned on account of the co-ordination of the 1894-95 and 1930 peaks and the 1900 and 1935 depressions. In this connection it is to be observed that the 1930 peak would probably have been much higher, if the year had been preceded by one, or two, years of rainfall in excess of the mean, instead of being preceded by three dry years. The application of this cycle would, however, appear to connote a peak about 1859 or 1860. If the Keele 76-year cycle, which is based on the Nile flood records from A.D. 640 (Proc. Inst.C.E., Vol. CCII, p. 389), and corresponding with the average period of Halley's comet, has any applicability, it might mean that the lake is only just entering a low level period corresponding with that from 1860 to 1882. It is worthy of note in this connection that Lake Baringo also shows dead tree stumps at about the same relative level as in the case of Lake Naivasha and it is reasonable to assume that the major periods of low and high level fluctuations of these lakes are due to a common climatic cause rather than some purely local one.

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V. G. L. VAN SOMEREN.

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A NATURAL HISTORY OF THE TURKANA FAUNA.

By D. R. BUXTON.
(*Photographs by D.R.B.*)

I. INTRODUCTORY.

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III. GENERAL REMARKS AND ZOOGEOGRAPHICAL SUMMARY.

I. INTRODUCTORY.

This article attempts to give a general idea of the fauna, more especially the invertebrate fauna, of the Turkana district. Turkana is the driest part of Kenya, drier even than any part of the Northern Frontier, and within its borders there are patches of desert almost as barren as the most desolate stone-wastes of the Sahara or Arabia. At the same time the country as a whole can only be described as semi-desert, and there is much to show that this semi-desert is of very recent origin. The fauna, as will appear, is by no means of pure desert character, but presents a mixture of elements, some truly typical of the desert, others deriving rather from the widespread savannas of tropical Africa. Nevertheless, the Turkana fauna is so far reduced and simplified by the very difficult conditions of life prevailing there that it can be much more easily studied than that of more favoured surrounding districts, where the innumerable forms of life interact in ways so devious and complex as to defy analysis.

Though this description refers more especially to Turkana, it will be found to apply almost equally well to the arid plains of the Northern Frontier District east of Rudolf; also in some degree to the adjoining parts of the Sudan and of Italian Somaliland, though in both these regions the appearance of more or less copious grasslands must modify the fauna. Further, the drier parts of Southern Kenya and Tanganyika, especially the Rift Valley bottom around the soda-lakes Magadi and Natron and the Masai country adjacent, appear to have much in

common with the northern wilderness; but there can be no doubt that the highland barrier has served to exclude from this southern territory many dry-country creatures whose centre of distribution is to the north.

It is curious to find in these similar but more or less disconnected areas, forms of life closely akin and at first sight identical, which nevertheless turn out on examination to show slight but constant differences. This may be true of many groups but is most noticeable among certain large beetles, especially the flightless Tenebrionids, whose comparative immobility has doubtless contributed to the isolation of local species or races within quite small geographical areas.

The area now in question is, however, a very compact geographical and faunistic unit. It lies entirely in the floor of the eastern or Kenya Rift Valley, bounded on the west by the Uganda escarpment and on the east by Lake Rudolf. To the south lie the Highlands of West Suk, Kamasia, and Lorogi (though a wedge of dry country pushes south between these latter to Baringo); to the north comes the desolate no-man's-land of the Ilembi triangle (where the Sudan serves in theory to separate Kenya from Abyssinia) whose stony hills merge into the Ethiopian mountains.

The level of Lake Rudolf is about 1,200 feet, and probably the greater part of the Turkana plains lie below 2,000 feet. It is therefore the lowest part of East Africa, with the exception of the coastal strip; it is also by far the hottest and driest, though hardly to be compared in this respect to parts of the Sudan.

The annual rainfall at Lodwar averaged less than five inches over the period 1923-1932, a figure generally low enough to induce desert conditions. Moreover, this rain is extremely erratic and commonly torrential when it falls at all; it therefore flows straight off the bare surface of the ground, fills the stream beds for a few hours and runs to waste. The temperatures prevailing in Turkana have a narrower range than is usual in a true desert, a fact which renders the climate trying to Europeans, since the nights are seldom cool enough to be refreshing. The maximum daily temperature usually approaches or slightly exceeds 100°F., while the minimum seldom falls to 70° and is usually much higher. This relatively equable temperature regime is probably due to the proximity of Lake Rudolf, which is a very large sheet of water. On the lake shore itself conditions are more equable still, with lower maximum and higher minimum temperatures. Relative humidity is generally very low, falling to 25 or 30% during the hottest part of the day, though by the lake, where the wind is generally blowing inshore, the figures are always higher.

These climatic conditions have determined a landscape and a vegetation of decidedly desert aspect. The constant dry weathering of the hills, helped by occasional downpours to clear away the debris of erosion, has produced a characteristic type of symmetrical, cone-shaped

hill rising with surprising abruptness from the plain. And the extreme flatness of the plains must itself be partly due to the torrential rains, which from time to time send a "sheet-flood" sweeping clean across country, depositing here and eroding there, so gradually reducing the entire surface of the country to a single level.

The plains bear but a sparse and scattered covering of drought-resisting plants. There are indeed areas of stony ground almost utterly devoid of vegetation; but usually a thin thorn-bush prevails, the individual bushes or clumps being separated by stretches of smooth bare sand. Looking down upon the plains from some steep hill, one may see that the area of bare ground generally far exceeds that occupied by vegetation and the general colour of the landscape is that of the ground. Only the courses of the dry stream beds, lined with thick bush and occasional trees, stand out dark by contrast to the intervening sands.

If one refers to Schantz's map in "the Vegetation and Soils of Africa" it appears that he classifies the Turkana vegetation with that of the Northern Frontier area, as "Acacia-Desert-Grass Savanna." The description applies well enough to the Northern Frontier (especially the more easterly parts which quite wrongly figure as "desert shrub") but not to Turkana, since here grass is almost entirely absent. Many parts of Turkana fit better into his description of "desert shrub."

In general the landscape is well furnished with flat-topped *Acacia* bushes of several species, growing up to about ten feet high. Often one may see them lying on their heads, having been picked up and thrown about by a whirlwind. Bushes of *Cadaba* and *Commiphora* are likewise numerous in places. Sometimes small tufted undershrubs, notably a *Disperma* (*Acanthaceae*) and a *Sericocomopsis* (*Amarantaceae*) occur in some abundance, and much resemble dried grass when seen from a distance. Elsewhere large succulent *Euphorbiae* abound and may even dominate the vegetation; they are accompanied by another *Euphorbia* which suggests a tangle of string thrown on the ground, and by a *Sanseveria* with long spiky leaves.

The banks of the Turkwell and a few other large river beds have thickets of branching Dom Palms, and occasionally, as at Lodwar, groves of huge acacias. But the most noteworthy feature of these situations is *Calotropis procera*, a large fleshy-leaved Asclepiadaceous plant, sometimes ten or fifteen feet high, which commonly grows in the river beds themselves. It has a wide distribution in dry situations from West Africa to Asia.

Here and there throughout the plains tall chimney-shaped termites' nests rise to surprising heights above ground; these are perhaps more characteristic of the Turkana landscape than any other single feature, and nowhere can they be seen so finely developed.

Such a country gives little scope for the life of larger mammals or of human beings. The mammals must abstain from drinking, either permanently or for most of the year, as water (except at the lake) exists only at the bottom of water-holes and in a few rock-pools, accessible only to the baboons. Giraffes exist, and a few Grant's gazelles may be seen inland; but the prevailing mammals are smaller: dik-diks no more than a foot high, are most characteristic of all, and ground squirrels and small mongooses abound in most parts.

A few birds reside constantly on the sandy plains. Apart from the Ostrich, one may mention a Bustard (*Afrotis gindiana*), a Stone Curlew (*Burhinus capensis affinis*) and a Courser (*Cursorius cursor*) as very characteristic of the arid, waterless country inland from the lake. Sandgrouse occur in small parties in the dry bush far from water, but are very difficult to see. They make regular daily flights to the lake or to water-holes, the Pin-tailed species (*Pterocles senegalensis*) arriving early in the morning; the Bridled (*Eremiolector sukensis*) after sunset. Doves are extremely numerous in the immediate neighbourhood of the water-holes, and arrive in thousands to drink in the early morning. Nightjars are locally common, probably preferring the neighbourhood of large river beds where the thicker vegetation harbours a large population of moths. They are mysterious and elusive birds: one may hear their "yap-yap" continually by night, but they are quite invisible on the sands and so seldom seen by day.

Early in 1934, when I first saw Turkana, it was a matter for surprise that any animal could support life there. It was towards the end of a long drought; the rains had failed for several successive seasons, and the previous year's fall at Lodwar had totalled less than an inch. The vegetation appeared almost entirely leafless and dead, but for a few trees growing in or near the river beds, which could still tap underground water. Yet even then the lesser fauna proved to be abundant and active to a quite remarkable extent; and when, at the end of April, rain at last fell in superabundance, the hordes of insects which made their appearance were an astonishment to see.

The Turkana tribesmen who populate this country to the extent of about two per square mile lead (apart from those few established by the lake) an entirely nomadic life, their movements dictated by the changing distribution of water and grazing. Towards the end of periods of drought they necessarily congregate near the few permanent water holes in the larger river beds, and certain rock-pools in the hills. After rain they spread themselves instantly over the whole country, to profit by the surface water and sudden crop of new grazing. The Turkana once depended largely on cattle, but now no longer so, for the grass, never abundant, has almost ceased to exist, except near the tops of the higher hills. Camels are now the mainstay of tribal existence, and Turkana, however dry, is good camel country.

The Turkana are an almost isolated community of camel users, for the neighbouring tribes in Abyssinia and the Sudan have none; in fact the whole southern Sudan is without camels. The connections of the Turkana breeds are with the Northern Frontier and Somaliland, whence they were derived, less than a century ago, via the south end of Lake Rudolf.

In this article the Turkana fauna is first classified according to various habitats, each of which is separately described. Finally, in the third section, some remarks are made upon the fauna from a more general point of view, and a summary given (as far as this is possible) of its zoogeographical composition.

The original collections and observations on which the account is based were made in 1934 in association with the Lake Rudolf Rift Valley Expedition. The collections have been handed over to various members of the staff of the South Kensington Natural History Museum, whom I have to thank for their kindness in furnishing identifications and information.

II. REVIEW OF THE FAUNA ACCORDING TO HABITAT.

I. THE PLAINS.

Most of Turkana is a level, sandy plain, though in many parts stones are freely scattered, and where the ground rises even slightly the winds and rains have prevented the accumulation of sand, so that in such places one finds little but loose stones, and crumbling masses of native rock here and there project from the surface.

It is the fauna of the level sands that presents most points of interest, for it includes most of those forms of life which connect Turkana with the northern and eastern deserts. One must distinguish between the ground fauna proper, and that which belongs rather to the vegetation of the plains; these are distinct, though they have their interactions.

The birds have been mentioned; the sandgrouse and coursers especially are part of the Turkana landscape, and seem to belong to the sands. But even these must fly to water—the sandgrouse daily, the coursers perhaps only occasionally—to satisfy their thirst. The creatures now to be described live entirely on the sands, and are totally independent of a water-supply.

Predators of the Sands.—The sand fauna is almost entirely nocturnal. A lamp placed on the ground at night will reveal many of its members, scurrying over the bare surface, and the flyers will gather from a distance, attracted by the light. It is a carnivorous community, presenting a scene of ceaseless mutual consumption. The ants and termites, deriving their sustenance largely from living or

dead vegetation and miscellaneous refuse, form the chief basis of existence, though moths and other immigrants furnish their share to the carnivores.

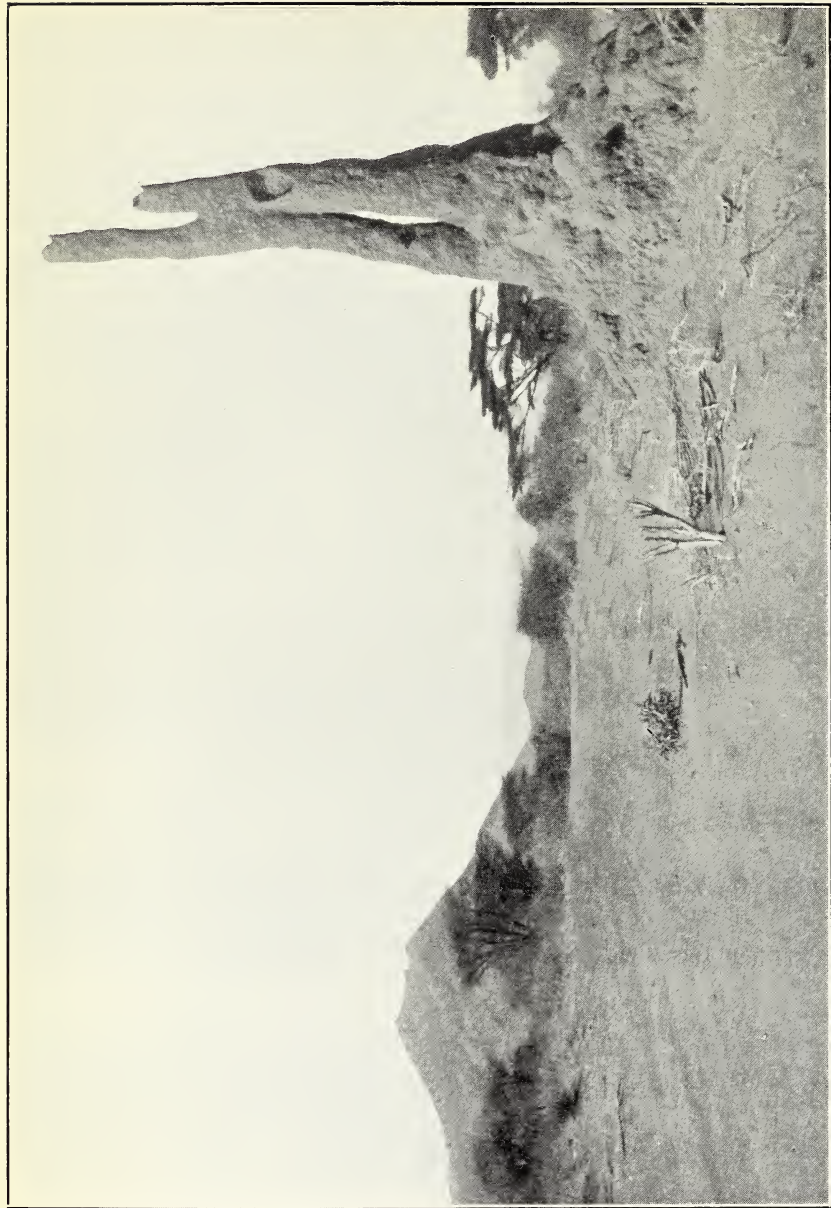
At night the ants and termites run freely over the sands, and many fall a prey to the small ant-lions, species of *Nesoleon* and *Creoleon*, whose funnel-shaped excavations often cover the ground. The ant-lions are nocturnal in Turkana; by day, when the sand is hot, and little prey abroad, they lie at a depth in the ground, but every evening they may be seen reconstructing their pits in preparation for the night's trapping.

The many other creatures which prey on the ants and termites run in pursuit, and many of them are swift runners. The Coleoptera are represented by many large and handsome ground-beetles: there are species of *Calosoma*, much like the English ones; *Megacephala*, of brilliant metallic green colour; *Anthia hexasticta*, a large black insect with white spots; and yellow-spotted species of *Chlaenius* and *Pheropsophus*, some of which eject on explosive liquid when disturbed. Almost all the bugs of the sands are carnivores of the family *Reduviidae*. The most conspicuous are *Rhaphidosoma* and *Lopodytes*, the former apterous, both strangely elongated so as to resemble Hydro-metrids; and *Holotrichijs*, of more normal form, with fully winged male and apterous female. All these genera are characteristic arid forms, widespread in the palaeoarctic deserts.

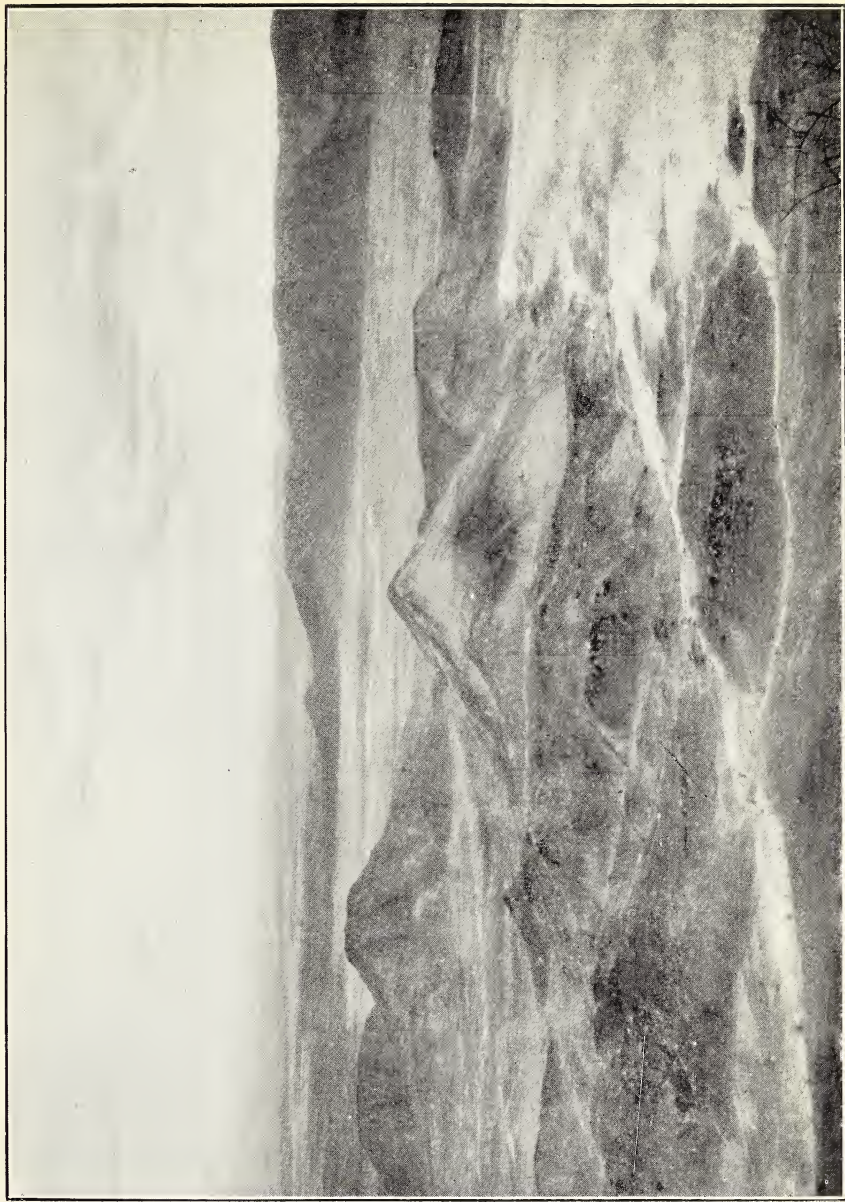
More formidable predators are the arachnids, which always flourish in dry sandy country. Large long-legged spiders of the family *Sparassidae* are frequent in Turkana, living under stones. Scorpions also come abroad at night in numbers; the prevailing genus is *Buthus*, but a huge species with flattened claws (*Pandinus*) also occurs. Most interesting of all are the *Solifugae* (locally called Tarantulas) which race with extraordinary swiftness over the sand, but sometimes come to a standstill when dazed by the light of one's camp fire. They run on only six legs, the front pair being tactile, and held up in the air behind the larger pedipalpe. They are provided with exceptionally large and powerful chelicerae. These *Solifugae* are of all sizes up to six inches long (though it may be that they exceed this length). The genus *Galeodes* has the longest and hairiest legs, and is small-bodied; *Solpuga* is intermediate, while the species of *Rhagodes* have very short legs but large bodies and terrible jaws, which can readily deal with the hardest beetles within reach of their gape. These arachnids are unequalled for sheer ferocity. If one of them be confined along with some insects, it will not rest until every one is killed. The moment something touches one of its sensitive hairs the *Solifuge* whirls round, mangles the offender in its formidable jaws, and, should it want no more food, abandons it until startled to furious activity by the next comer.



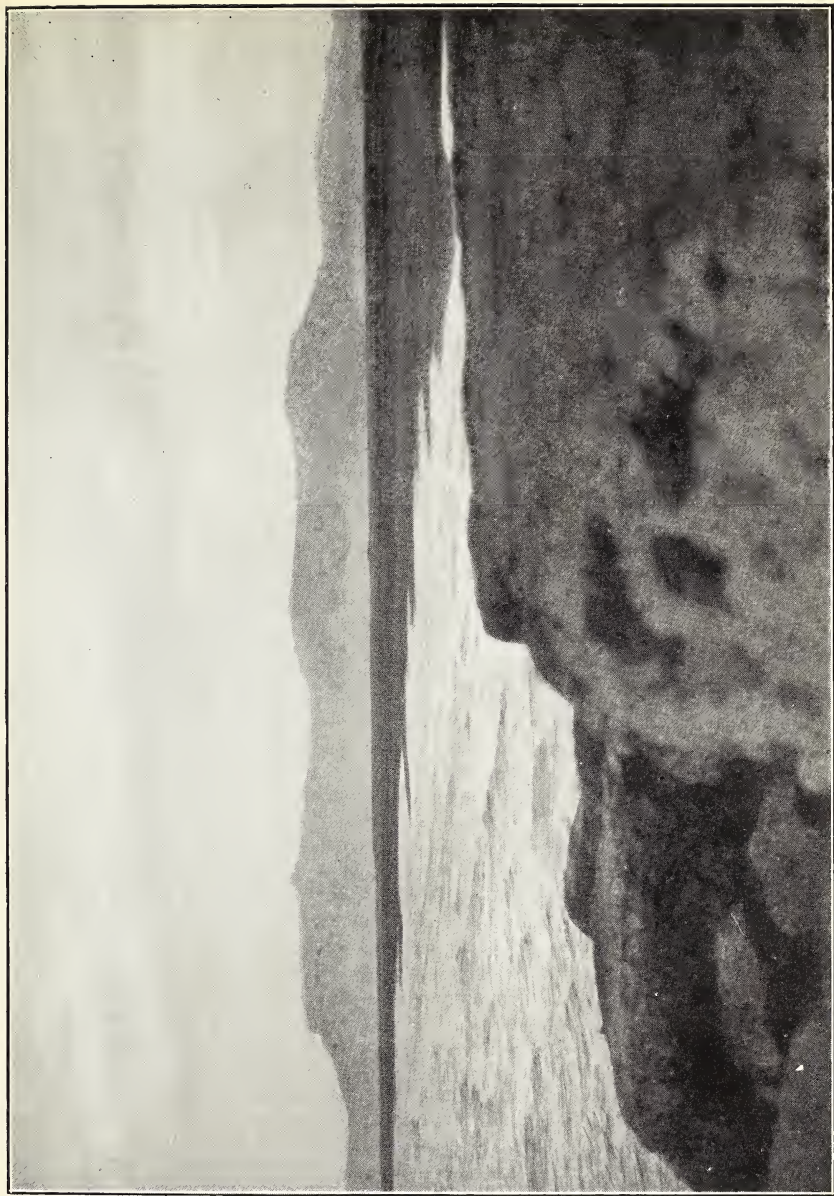
Murneris Hills, near Lokitaung. A very characteristic Turkana landscape.



Kitale—Lodwar road. View south towards Nepau escarpment, with a double termites' nest.



From Lodwar Hill. View north-west.



Lake Rudolf and Labur.

These great arachnids—spiders, scorpions, and *Solifugae*—themselves form the exclusive food of the sand-vipers (*Echis carinatus*). These are fierce little snakes, which lie coiled up under stones and fallen timber by day and make a hissing noise (apparently by the friction of their scales) when disturbed.

Other reptiles, insect feeders, take their toll of the sand fauna, and of those insects which live in the vegetation, but fly abroad at night. Such are the skinks, which preponderate over true lizards in the desert. Many of those which live in the sand have much reduced limbs, and progress by wriggling in the manner of snakes (genus *Riopa*). The true lizards remain runners; they are represented by the small long-tailed desert lizards *Eremias* and *Latastia*. The geckoes (*Hemidactylus*) are active nocturnal insectivores, feeding for preference on moths. All these reptiles probably fall a prey to the Sand Boa, *Eryx colubrinus*, a stumpy sand-coloured desert snake which constricts its prey after the fashion of the large Boas, and when inactive lurks buried in the sand.

The Scavengers.—Leaving the predators, one must refer to the scavengers, another important community of the sands. Among these are numbered the large black Tenebrionid beetles which are more characteristic than any other insects of the desert fauna. Commonest of all is *Pimelia hildebrandti*, which might be called the national insect of Turkana. It is a well armoured insect, and can have few enemies; but nevertheless falls a victim to the great monitor lizards (*Varanus ocellatus*) which live among rocks and trees. The *Pimelia*'s feeding habits are obscure, but it will eat such unattractive fare as the chitin of dead scorpions. It scours the ground very thoroughly, for any stretch of smooth sand will be found in the morning to be covered with tracks, running in all directions. *Phrynocolus placidus* is a Tenebrionid of similar dimensions, with heavily corrugated elytra. The genus *Vieta*, all brown and hairy sand dwellers, is represented by several species. *Arthrodibius major* and the species of *Zophosis* are further black wingless ground-dwellers of the same family; many others, furnished with wings, come to light in the evening; they do not appear to belong to the sands and their way of life is little known.

One of the commonest scavengers is a *Trox* (*T. incultus*) which lives on dead animal matter and dung, and flies to light in numbers. The dung-beetles proper (*Coprinae*) also abound wherever wild or domestic animals are numerous.

The crickets (*Gryllidae*) are a frequent group, and their song is seldom silent after sundown. They include a large species (*Gryllus bimaculatus*) as well as the smaller house-cricket (*Gryllulus domesticus*), which has become cosmopolitan as a domestic insect. *Blattidae* (cockroaches) are also fairly numerous, and a curious desert genus, *Polyphaga*, is sometimes found lurking under stones. Its members

are very short and broad, and apterous, so as somewhat to resemble certain marine Isopods. One may also mention, in this category of scavengers, the *Thysanura* (*Machilis*, etc.), *Collembola*, Pseudo-scorpions, and mites.

Immigrants.—Among those insects which depend obviously on the vegetation, but wander abroad at night (sometimes to be eaten by the predators of the sands), the *Cerambycidae* or longicorn beetles whose larvae burrow in wood are conspicuous. A great many species live in Turkana, and many of them are attracted to light. Some of the large species, which are among the most handsome of insects, may be found by day under the loose bark of dead acacias. Others are extremely cryptic, and spend the day fully exposed on the branches and trunks of trees, but can seldom be seen. The *Bostrychidae* and other small families of wood-boring beetles are abundant; so are Rutelids, Melonlonthids, and Elaterids, whose larvae are all root feeders.

Many moths come forth at night, and are much sought after for food, especially by the geckoes, bats, and nightjars. The commonest and most conspicuous are certain large Noctuids of genera widespread in tropical Africa. The most abundant is *Sphingomorpha chlorea*, closely followed by *Gyligramma latona*, a large moth with a great expanse of wing, but with very drab white and grey coloration.

Another group of insect carnivores, the Mantids, invade the sands at night and may be observed to feed there, though they belong rather to rough stony ground and the thin dry bush which grows in such places. Certain genera of small grey or brown coloured mantids—*Elaea*, *Tarachodes*, *Charieis*, *Tarachina*—apparently flourish in these dry habitats, and are very frequent in Turkana. The individuals attracted to light are invariably males, the females being of much heavier build and often quite flightless. I never myself collected the females of any of these genera, but I once unearthed a burrowful of provisions buried in the sand by a large Sphecoid wasp (*Stizus lughensis*) and these consisted exclusively of the brachypterous females of *Elaea* and *Tarachodes*. They had evidently been collected by the wasp from the bare rocky ground of the surrounding country, which they very closely resembled in colour.

Two other Mantids of occasional occurrence near the larger river-beds, where there is vegetation sufficiently luxuriant to house them, do not properly belong to the dry-country fauna. These are *Tenodera superstitiosa* and *Hierodula viridis*, both large species of green colour, very widely distributed in Tropical Africa.

Other members of this interesting group—one sand dweller, and two from the mountain grasslands—will be mentioned in their proper places.

The diurnal fauna of the sands.—The sand fauna described above is almost entirely nocturnal. The large white-spotted Carabid *Anthia* has indeed the reputation of having diurnal habits, but I never saw one abroad in Turkana until dusk. The sand fauna is not even particularly easy to find by day, for the smaller loose stones do not afford enough protection from the heat, unless they lie in shady places. The nocturnal creatures mostly lie up under the largest boulders or prostrate tree trunks (where such exist), or they resort to deep crevices among rocks, or holes in the ground.

There remain to be described a small assemblage of insects whose period of activity is the heat of the day. These are undoubtedly the most interesting members of the desert fauna, since they have to withstand temperatures on the sands which one would expect to be lethal. During the greater part of the year the Turkana sands reach a surface temperature of 130 to 150°F. for some hours daily, yet even at this hottest period certain members of the fauna remain active.

The only beetles to be seen are members of the Tenebrionid genus *Zophosis*, small oval black creatures, which may be seen running and tumbling with desperate haste on sand or among stones at any time of day. *Hemiptera* are represented by the Reduviid genus *Holotrichijs*, especially by their young, which are generally so coated with sand and debris as to be unrecognisable. The wingless females sometimes patrol the sands, but the males, which fly to one's lamp by night, apparently spend the day elsewhere.

The remaining diurnal ground-dwellers are all *Orthoptera*. They include the typical desert grasshoppers, mostly species of depressed form closely matching their environment. Of these the much flattened genus *Chrotogonus* is found wherever there is bare ground in Africa. Other species, special to desert or semi-desert country, are four of *Sphingonotus*, two of *Platypterna*, two of *Pycnodictya*, an *Acrotylus*, and a *Scintharista*. Of these, three species are new and as far as yet known endemic to Turkana (*Sphingonotus turkanae*, *Pycnodictya dimorpha turkanae*, *Platypterna saffiana*). Many other Turkana species belong to genera characteristic of dry savanna rather than desert country; others again are not specially characteristic of arid country at all.

The geophilous genera are often remarkably variable, and closely resemble the background on which they live. Thus *Sphingonotus canariensis* and *savignyi* are both of lighter colour and more speckly when they occur on open sandy ground, while in a stony habitat where stones of different colours are strewn on the ground they exhibit a range of grey, brown, and pinkish shades. Some species, though extremely inconspicuous when at rest on the ground, leap into prominence as soon as they take flight; such are *Scintharista notabilis brunneri* and *Acrotylus longipes incarnatus*, both with red on the wings.

Perhaps the most interesting of all the sand dwellers is a curious desert Mantid identified as *Eremiaphila cordofana*. The genus is peculiar to desert country, and is represented by several species in the various Palæartic deserts. These insects live on the bare sand often far from stones or any other cover, and it would be difficult to say what other creatures they can find to feed on. In form they are unlike other Mantids, being very short and broad, with almost circular abdomen partly covered by vestigial elytra; but their four running legs are long and enable them to move with surprising speed. Their colour matches that of the sand so well that it is practically impossible to see these insects unless they move.

Termites.—The termites play an important part in the economy of nature in Turkana just as do their nests in the outward semblance of the landscape. But for their unceasing and ubiquitous activities, the country would be largely encumbered with dead brushwood, which in that arid climate could never rot away. The amount of dry vegetable matter annually disposed of by the termites must be quite beyond computation.

Some termites wander at large on the sands at night, and these, as has been mentioned, are liable to be eaten by various carnivorous insects and arachnids. But the chief insect enemies of the termites are Ponerine ants, which invade the nests in companies, and finally emerge bearing numbers of mangled termites in their jaws. One sometimes meets processions of some hundreds of these large stinging ants on the march; they break up and scatter when approached too closely, producing at the same time a very audible stridulation. One of the most peculiar of African mammals, the Ant Bear, inhabits the Turkana plains, and probably lives entirely off termites, ripping open the nests at night with its exceedingly powerful claws. The large soldier termites, which readily draw blood on the human skin, would be an annoyance to most animals interfering with the nests, but the Ant Bear is protected against these by an unusually tough hide.

The principal termite of Turkana, builder of the chimney-nests, is *Macrotermes bellicosus*, a species of immensely wide distribution in Africa, though it does not by any means always build the same type of nest, and in some places builds none at all. The material of the nests, consisting of sandy soil compacted with a salivary secretion, is extremely hard when dry, but readily softened by rain; it is doubtless for this reason that the finest specimens of the chimney nests occur in the exceedingly dry Turkana climate. There they may be seen rising to 25 feet or more, but stories of nests exceeding thirty feet tend to arouse one's scepticism.

These nests have a more or less conical base accounting, in well-developed specimens, for little more than one-third of the total height. This is surmounted by a tall chimney of almost constant diameter; a

genuine chimney, hollow inside and open at the top. It is impossible to say what prompts the termites to build these extraordinary nests, and difficult to be sure what useful function is served by the chimneys. If one's hand is introduced into the chimney of a flourishing colony the air inside feels warm; but in fact this air is no warmer, by day, than the outside atmosphere, and feels so only because it is damp. The inside air may have a humidity of 80° while outside it is no more than 30°; this is due to constant evaporation from the fungus gardens maintained by the termites in the inner regions of the nest. There is certainly no regular circulation through the chimney; but since the inside temperature must be relatively constant one would expect some upward movement at night, when the inner air should be warmer than outside, while during the heat of the day the tendency would be the other way.

One can only speculate as to the source of the water with which the fungus gardens are kept perpetually moist, but it seems probable that the termites bring it up from the subsoil. Their excavations certainly penetrate to great depths below ground. In the ordinary course they cannot obtain water in sufficiency for building; this happens only after rain. When a substantial fall has occurred the termites build tirelessly, even during the day, when they are not usually to be seen in the upper parts of the chimneys, exposed to the light of day.

A considerable community of strangers share the great territories with those that build them, on terms of mutual toleration. A small "parasitic" termite, probably *Microtermes incertus*, is almost invariably present in the lower part of the nests, where it excavates its own system of galleries, and chambers where large fungus gardens of most beautiful construction may be found. Many species of ants also take up their quarters in the termites' nests, and make their own passages, which never meet with those of the other tenants of the structure. The chimneys of these nests, with their very humid atmosphere, afford perfect shelter for the soft-skinned geckoes, one or two of which are almost always present. When the colonies are moribund or dead—as most of those in some of the driest parts appear to be—the nests develop numerous holes, in which mice and other creatures find temporary refuge.

2. THE MOUNTAINS.

The rocky ground near the foot of the mountains has a somewhat different assemblage of inhabitants from the neighbouring sands. The arachnid groups are not prominent here, for they prefer to run on open sandy grounds. The small grey dry-country Mantids, whose females are mostly short-winged, seem to flourish in these stony places, and certain grasshoppers (notably *Sphingonotus rubescens*, whose colour closely harmonises with the dark volcanic rocks) are

almost confined to such situations. Some very fine large Myrmeleonids, unknown to the sandy country, also occur here (*Palparellus rothschildi*, *Palpares klugi* and *papilionoides*).

Some parts of the mountain slopes are clothed with a very thick scrub which harbours a considerable insect population, and in these places lizards are particularly numerous. There are skinks, all swift runners with fully developed limbs (*Mabuya*), true lizards, monitors, and Agamids with their usual brilliant red and blue decoration.

Wherever a large outcrop of deeply fissured rock occurs one may expect to find the giant millipedes living. As a rule their presence is made known only by numbers of dead specimens and odd rings which litter the ground, for these creatures only emerge (at least by day) after rain has fallen—an uncommon occurrence in Turkana. They very quickly expire when exposed to strong sunlight, and it seems that they must sometimes be caught and killed in numbers by the sun, when drawn out from their rock-recesses by a day-time shower. One commonly finds fresh specimens lying dead on the ground on such occasions.

The mountains have their special fauna of mammals. Ignoring the nocturnal carnivora, such as leopards, hyaenas, and jackals, one may mention a few highly characteristic creatures which can be seen by the light of day. Hyrax live among the rocks, and, like marmots or rabbits in Europe, lie out in the sun by day, within easy reach of their retreats into which they quickly bolt when approached. Troops of baboons, whose agility in rock-climbing is almost incredible, are often met with in the hills. They pay frequent visits to rock-pools, which they reduce to a very messy condition. Higher in the mountains one may meet the Klipspringer, a small greenish-brown antelope which alone of its tribe has taken to a life among rocks. It is wonderfully sure-footed and takes prodigious leaps from rock to rock.

The grasslands which occur towards the tops of the higher mountains are the only habitat in Turkana where the typical dry-grass fauna of the African savannas can find congenial conditions of life. In these habitats, at four to five thousand feet above sea-level, one can collect grasshoppers and Mantids, mostly straw-coloured and of slender form, quite unlike those of the plains. Some of these are species characteristic of grassy country at the same level to the west and south of Turkana. On the other hand the isolation of these mountain masses has enabled endemic species to develop; thus a new grasshopper (*Brachycrotaphus brevis*) and a new Mantid (*Oxythespis parva*) were collected on Mount Kaitherin.

3. THE LAKE SHORE.

The shore of Lake Rudolf has a community quite distinct from that of the inland sands, for it provides two habitats which have no

counterparts away from the lake : a belt of permanently green grass-land, and a narrow zone of damp sand close to the water's edge.

The damp sandy zone, saturated with the soda-solution of the lake water, harbours thousands of midge (Chironomid) larvae, and is dotted with small vertical burrows in which the carnivorous young of the Tiger Beetles live. These larvae are evidently sought after by the sandpipers and other small waders which frequent the shoreline. Under every loose stone one finds earwigs, probably *Labidura riparia*, a species which always affects the vicinity of salt or soda-containing water. These earwigs show an extraordinary variation in individual size, the largest adults, about two inches long, being almost double the length of the smallest. The earwigs are probably the scavengers of the shoreline.

Various small flies frequent the water's edge, and these constitute the chief food for the remainder of the community. A certain black-and-yellow solitary wasp (*Bembex* sp.) is always present, engaged in hawking the flies with which to provision its burrow. The wasp flies steadily up-wind, following the shoreline, and maintaining a height of about a foot above ground. If disturbed it immediately loses equilibrium and is blown out of sight by the strong wind, but soon regains control and reappears, working up persistently in the same direction as before.

The most conspicuous insects of the shore region are Tiger Beetles (*Cicindelidae*) which live here in enormous numbers, probably preying upon the smaller flies which abound near the water. They take so readily to flight when disturbed and are so active on the wing that one might mistake these beetles for flies at first sight. Three species are represented, two of which, *Cicindela nilotica* and *brevicollis*, both small, are extremely abundant, while a third larger species, *C. dongalensis*, is comparatively uncommon. The common Pratincole of the lake shore, *Glareola pratincola fulleborni*, a bird of somewhat tern-like flight and great agility on the wing, was found to be feeding almost exclusively on these *Cicindelids*, together with an occasional earwig.

The dragonflies are a group well represented in numbers by the lake, though the species are only two. One of them, *Brachythemis leucosticta*, is an abundant insect near water all over East Africa. The other, *Paragomphus pumilio*, is known mainly from the Sudan region. These dragonflies, like the other carnivorous insects of the shoreline, feed on small flies, and it is noteworthy that they remain active long after sundown so as to profit by the midges which then come abroad. Other insects noted by the lake were a caddis and a small mayfly, both dependent on the water for their larval stages.

The sand fauna away from the immediate shoreline includes many of the same creatures as inland : the same large Tenebrionid beetles *Pimelia* and *Phrynocolus*, the same Arachnids, and the small sand-viper

Echis carinatus which feeds on them. But the lake-shore sands are never heated to such high temperatures as elsewhere, with the result that these creatures spend the day much nearer the surface and can be found under small stones, and in similar accessible places. One special grasshopper, *Conipoda gracilis*, is found only on the open sands near the lake; it is a speckly species hardly visible on the sand. Two species of *Sphingonotus*, *S. canariensis* and *savignyi*, also occur on these sands, where they assume a lighter colour and more speckly pattern than elsewhere.

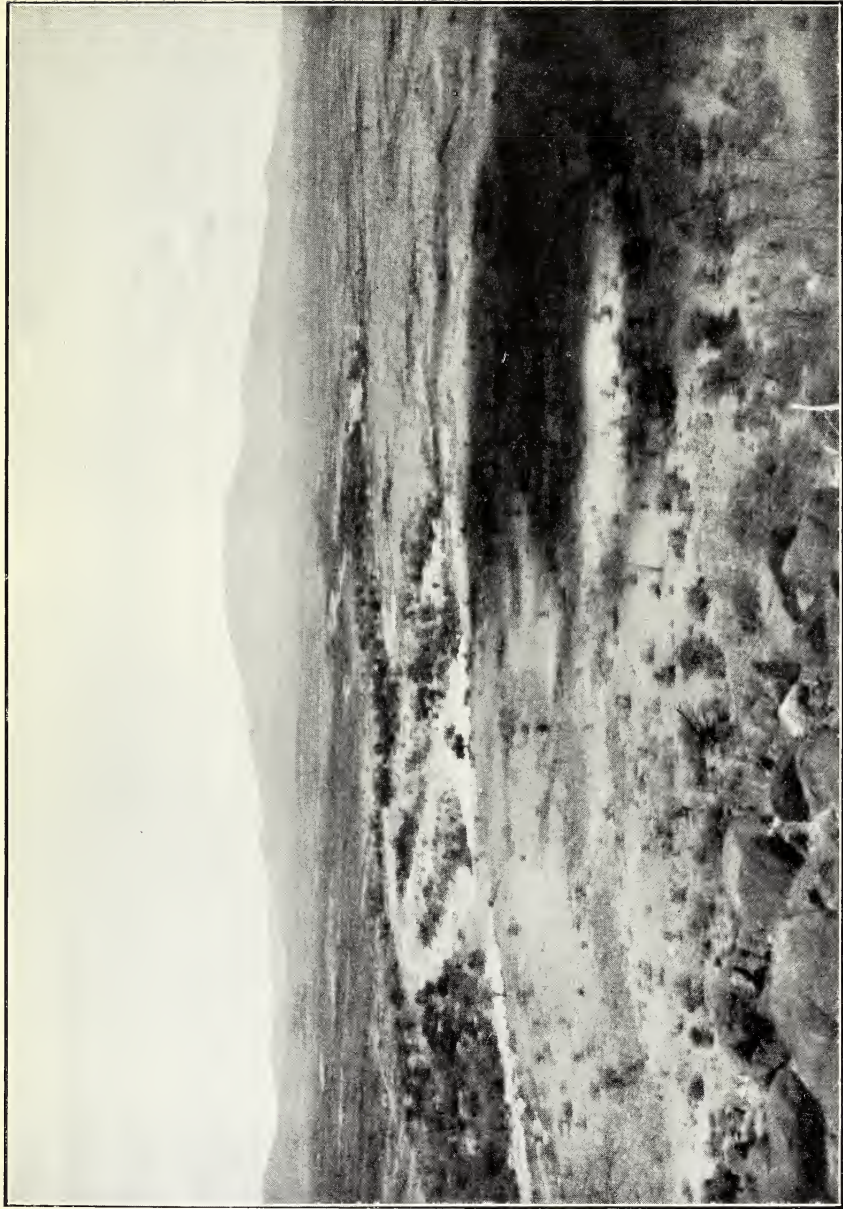
Some parts of Lake Rudolf shore, such as Ferguson Bay in the middle of the west coast, have considerable areas of natural grassland, consisting almost entirely of a prickly species, *Sporobolus spicatus*. These are the only areas of permanently green grassland in Turkana. The same areas are utilised by the natives for cultivating mtama or millet (*Sorghum*), and wherever a plantation has been established grazing is prevented, so that the grass, usually cropped down to the ground, is enabled to grow long. These occasional patches of longer grass have a very large population of grasshoppers, most of which are not to be found elsewhere in Turkana.

The grassland genera include *Oedaleus*, *Aiolopus*, and *Platypternodes*, of which an endemic species, *P. rudolfi*, was collected. A very characteristic species, found only in dry conditions where water and good grassland nevertheless occur, is *Calephorus venustus* (formerly *compressicornis*). Finally, these grasslands were found to harbour an apparently permanent colony of the African Migratory Locust, *Locusta migratoria migratorioides*, the habitat requirements of whose solitary phase are very similar to those of the *Calephorus*.

4. THE ROCK POOLS.

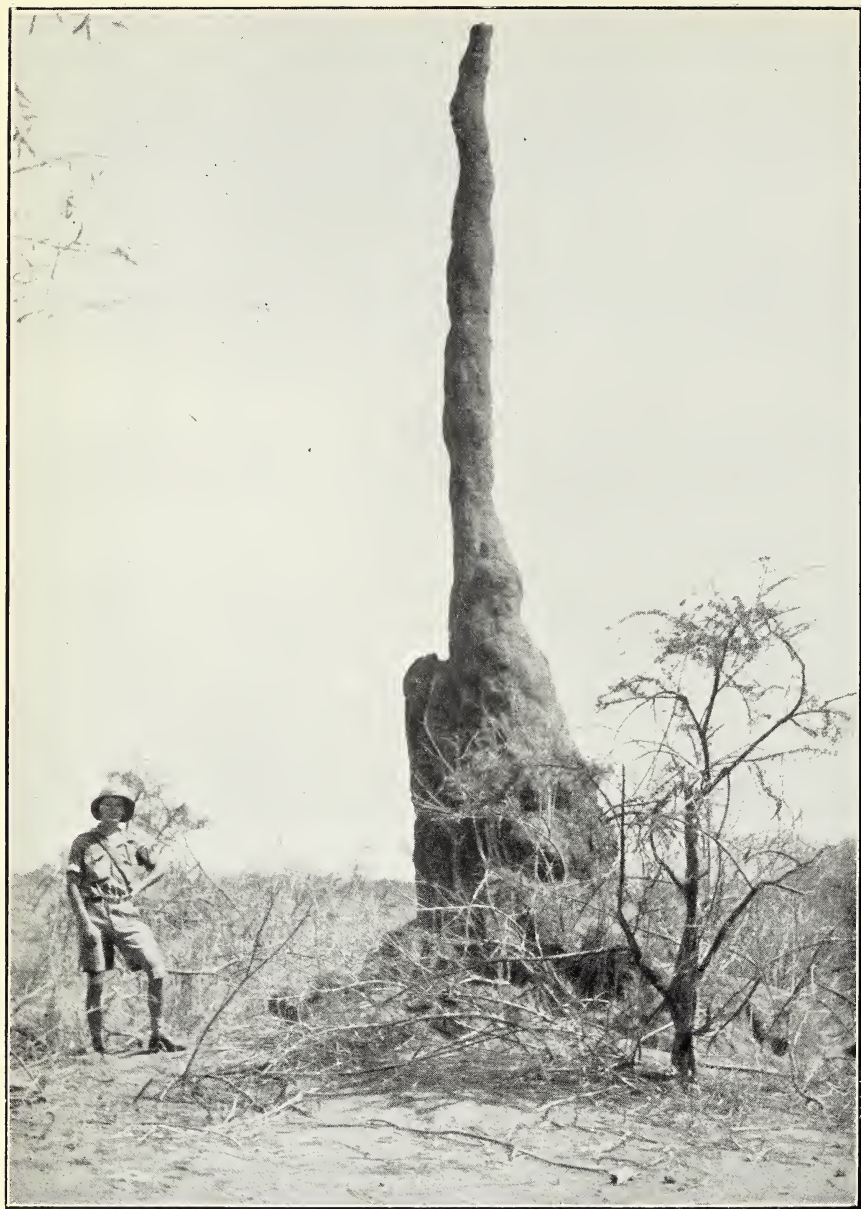
These are virtually the only permanent and stable aquatic habitats away from the lake in Turkana, since even the largest water-holes in the river beds change their location from time to time, and provide little opportunity for continuity of life. Both water-holes and rock-pools do however serve as drinking places for numbers of creatures which require water regularly, so a considerable terrestrial community depend upon these sources of water for their continued existence in the arid country.

The birds have already been mentioned in this connection; the most regular visitors are the Pin-tailed and Bridled Sandgrouse, whose drinking hours are respectively the early morning and the evening, and the doves, which live only within easy reach of water. Among insects the most persistent frequenters of the water-holes are *Hymenoptera*, including various bees and solitary wasps, mainly *Eumenidae*. Syrphids (hover-flies) and a few butterflies also assemble there.



Moroto Hill from a small hill near the Moroto Road.

PLATE F.



Termites' nest 22 or 23 feet high.

PLATE G.



Rock pool at Naramum (Sudan territory).

PLATE H.

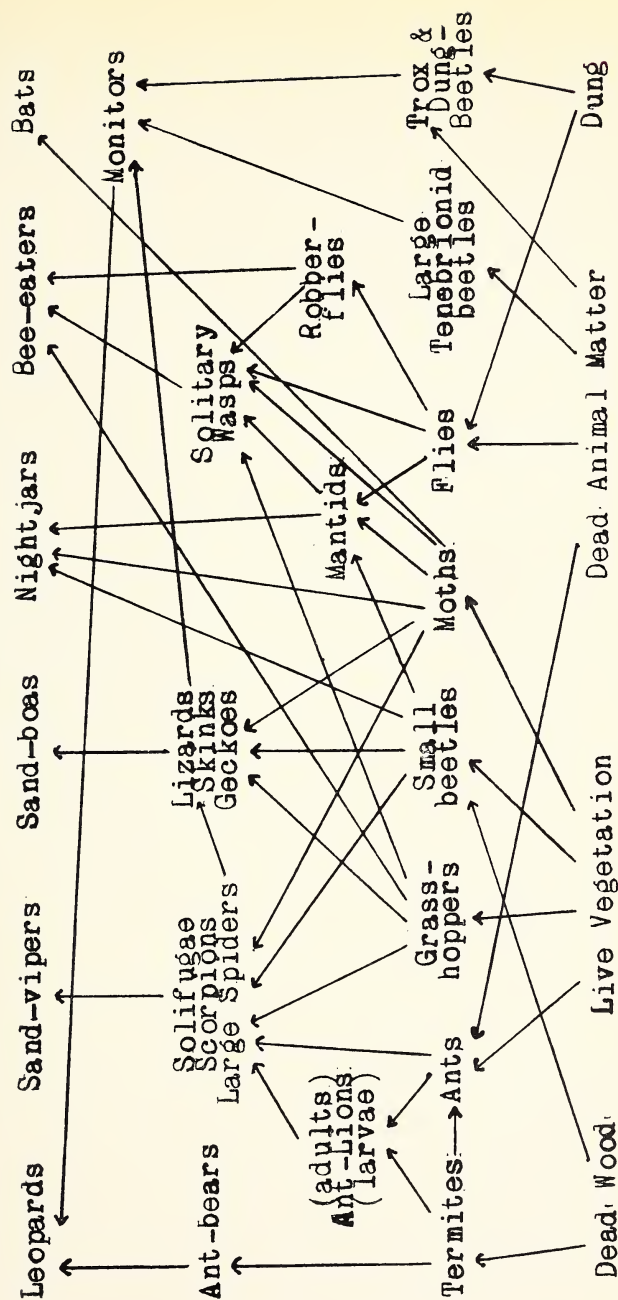
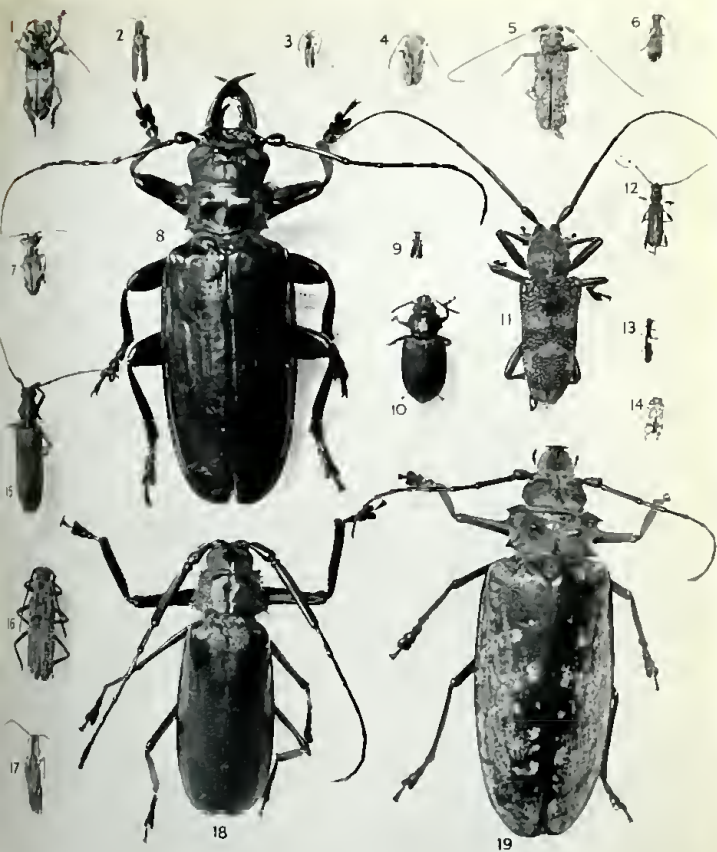


Diagram showing some of the food-chains among the Turkana sand-fauna.



GROUP OF LONGICORN BEETLES (CERAMBYCIDAE)

Natural size

This is one of the best represented families of beetles in Turkana, and contains some very striking insects. The larger species are often found under loose bark, whence they emerge at night. Some of the smaller ones are very cryptically coloured (e.g. 1, 4, 5, 7) and can hardly be seen when sitting motionless on the bark of a tree. Few identifications are available.

8. *Acanthoporus negansanus*. 11. *Ceroplesis* sp. 15. *Plataea bennigseni*.
18. *Macrotoma palmata*. 19. *Tithoes confinis*.



GROUP OF MANTIDAE

Natural size

A great variety of Mantids is found in Turkana. 8 and 9 are widespread East African species dependent on green vegetation. 2 and 3 are attenuated species from mountain grassland. Most of the remainder appear to live in sparse dry bush, but 15 is confined to bare sand. 13 and 14 are the short-winged females of 11 and 5.

1. *Tarachina raphidioides*. 2. *Oxythopsis* sp. nov. 3. *Hoplocorypha lacualis*.
4. *Catasigerpes niloticus*. 5 and 14. Male and female of *Tarachodes alluaudi*.
6. *Miomantis paykullii*. 7. *Parasphendale minor*. 8. *Tarachodes orientalis*.
9. *Tenodera superstitiosa*. 10. *Hierodula viridis*. 11 and 13. Male and female of *Elaea marchali*. 15. *Eremiaphila cordofana*.



FAUNA OF THE LAKE RUDOLF SHORE

Natural size

All these insects are confined to the lake shore with the exception of 10 and 11 which are common Tenebrionid beetles throughout the sandy country. 11 is indeed the most characteristic insect of Turkana. The Tiger Beetles (1, 2, 3) are extremely abundant and active by the lake shore. The solitary wasp (4) probably preys upon the Anthomyid flies (9). The earwigs (12 and 13) are all adult, and show remarkable variation in size. 14 is a Caddis Fly.

1. *Cicindela nilotica*. 2. *C. dongalensis*. 3. *C. brevicollis*. 4. *Bembex* sp.
5 and 6. *Brachythemis leucosticta*. 7 and 8. *Paragomphus pumilio*. 9. *Lispe*
sp.? 10. *Phrynosoma placidus*. 11. *Pimelia hildebrandti*. 12. Males of
Labidura riparia. 13. Females of the same. 14. *Dipseudopsis himbarensis*.

Something may now be said of two rock-pool faunas. The one belongs to a series of pools at Lokitaung, in the Labur mountains near the northern end of Lake Rudolf; the other to a very isolated pool at Naramum, beyond the Kenya border.

The Lokitaung pools have a fauna much resembling that of similar habitats anywhere. An abundant growth of green algae supports the herbivorous members of the Hemiptera and other usual aquatic groups. The Larvae of mosquitoes and midges doubtless provide the principal food of the carnivorous insects, which include Dytiscid beetles, water-scorpions (*Nepidae*) and the larvae of several very widely distributed dragonflies. A frog, *Rana oxyrhinchus*, is common and probably makes use, in its various stages, of the greater part of the other life of the pools.

A Tiger Beetle, *Cicindela alboguttata* (a species never found by the lake shore) finds breeding sites near the edge of these pools, as also does a luminous Lampyrid (glow-worm), whose larviform females seem to be almost amphibious. The rocks which in places overhang the water of the pools harbour a gecko, *Hemidactylus brookii*, the same species which occurs in the chimneys of termites' nests.

The Naramum pool, which is the only source of water for a very large area, lies in a deep rock-crevice, so narrow that a large boulder has become wedged between its walls and hangs over the heads of those who come for water. This pool is twenty to thirty feet long by about seven feet deep, and its water maintains a constant temperature of 74°F. It contains an animal community quite different from that of Lokitaung; one almost as limited and as peculiar as it is possible to imagine.

Aquatic insects were found to be very scarce in the pool, and totally inadequate to support a huge population of frogs which seemed to be the chief occupants of the place. The frog is a species of *Xenopus* (*X. clivii*), a genus of entirely aquatic habits, related to the so-called Surinam toad of S. America. The pool swarmed with the curious transparent larvae of the frog, which grow to an enormous size and resemble small cat-fishes rather than tadpoles. They swam together in shoals, until the period of transformation when their habits changed. The adult frogs spent most of their time at the bottom of the pool, but sometimes floated at the surface for a considerable time; if these were disturbed they took a hasty gulp of air before diving to the bottom.

The food of the tadpoles must have been the green algae and microscopic plankton of the pool; but that of the adults was by no means obvious, for insect life was altogether insufficient for their needs. A snail (*Physopsis ovoidea*) was present in some numbers, and it seemed that these might contribute to the food supply of the adult frogs. However an examination of the stomach contents of the single

adult captured has revealed no trace of snails, or of insects. The specimen in question had been feeding exclusively on the larvae of its own species.

This strange form of cannibalism was perhaps induced by the unusual economy of the habitat, where there was a dearth of intermediary organisms fitted to make the microscopic life available for the adult frogs. It may be that only by falling back on their own abundant tadpoles to fulfil this necessary function could the frog population exploit to the full the resources of the pool.

A Giant Water-bug, *Lethocerus niloticus*, one of the few insects directly predatory on vertebrates, completed the fauna of the Naramum pool. A specimen was caught actually holding a young frog transfixed on its large raptorial fore-limbs.

5. THE EFFECTS OF RAIN: TEMPORARY HABITATS.

A heavy fall of rain has very remarkable effects in the semi-desert country. The innumerable seeds which have lain on the ground through the period of drought at once germinate, so that in a few days the ground is turned green by thousands of seedling plants. The dry acacias put out leaves, and here and there handsome bulbous plants, especially the red and yellow *Crinum* lilies, spring up from the bare ground.

Simultaneously there occurs an outburst of insect life. The species observed before the rains mostly appear in vastly greater numbers, and many new ones are seen for the first time. Among the beetles which came to light immediately after the Turkana rains of April, 1934, swarms of small chafers (*Melolonthinae* and *Rutelinae*) and of small longicorns were especially conspicuous. Later on extraordinary numbers of grasshoppers (mainly *Oedaleus*) made their appearance along with the ephemeral vegetation, and in places Meloids (oil-beetles) whose larvae had probably been feeding on the grasshoppers' eggs, occurred in great numbers. The species included several black-and-yellow or black-and-red *Mylabris*, and a beautiful metallic-purple *Cyaneolytta*. Butterflies appeared, though in small numbers; the commonest species were *Danaida chrysippus* and its mimic *Hypolimnas mysippus*, both of wide distribution.

The acacias after the rains resounded with the song of Cicadas; the wet must have prompted their nymphs to emerge from the ground and transform. A huge brown Buprestid beetle, *Sternocera druryi*, had also emerged in great numbers. These creatures generally hung among the topmost twigs of the acacia bushes, where they were absurdly conspicuous and impossible to overlook; but their extreme hardness no doubt protected them from the attacks of birds.

A further effect of the rain was greatly to activate the whole of the ground fauna. The scorpions and *Solifugae* appeared in largely in-

creased numbers, and some of the nocturnal Tenebrionid beetles, notably *Arthrodibius major*, began to show themselves by day. Still more remarkable was the appearance on the sand of innumerable monstrous mites (*Trombidium*) which had never been seen anywhere before the rains. These mites were of beautiful velvety texture and brilliant red colour, and grew to nearly half an inch in length. They belong to the same genus as the European Harvest Mites, whose adults are believed to lead a subterranean life, living on the root systems of plants. Possibly these large African species of *Trombidium*, which seem to spend the greater part of their existence buried in the sand, maintain life in the same way.

An unexpected result of the Turkana rains was the hatching out of locusts (*Locusta migratoria migratorioides*) from eggs which must have lain in the ground some considerable time. Occasional individual locusts arose under natural conditions, but a far larger number appeared at Lodwar, in the mtama (millet) plantations which had been established after the flooding of the Turkwell. There is reason to suppose that the eggs which gave rise to this population had lain in the ground for two years. A smaller number of other large grasshoppers, *Gastrimargus volkensi* and *Cyrtacanthacris tatarica*, as well as the long-horned grasshopper *Homorocoryphus nitidulus*, appeared along with the locusts.

Another notable creature brought out by the rains was a large tortoise, *Testudo pardalis*. It is an uncommon animal in Turkana, and contact with it is supposed by the natives to have beneficial effects. If one be encountered on the march one's Turkana retainers will rush to the beast in high excitement, and then alternately lay their hands on its shell and touch their head or chest.

One effect of the rain is to produce a multitude of temporary pools, and these are quickly colonised by various water-loving insects—dragonflies, mosquitoes, water-beetles (especially the Dytiscid *Eretes*) and *Hemiptera*. Probably most of them—and certainly the dragonflies—reach these temporary habitats by flying or being blown there, but it is remarkable that certain pools, at great distances from any permanent water, should be colonised so rapidly, especially by the mosquitoes. One is led to speculate whether the eggs of some mosquitoes and perhaps other insects can survive periods of drought, like those of the phyllopod Crustacea.

The rivers which flow for a time after rain also acquire a large fauna, remnants of which one finds inhabiting puddles after the river has ceased flowing. Vast numbers of frogs (*Rana delalandii*) appeared in the Turkwell at Lodwar when that river had been flowing; it is even said that small fishes occurred. Probably the eggs of both frogs and fishes had been washed down from the permanently flowing headwaters of the river. On the other hand various flying insects (dragon-

flies, Tiger-beetles, the wasp *Bembex*, etc.) must have followed up the course of the flowing river from the lake. Very few of the creatures can be of local origin, for the water-hole-fauna is extremely limited; and most of them must perish when the rivers cease to flow and the numerous puddles dry up.

At least one group of river-dwellers do, however, contrive to live through the long periods of drought between the rare and short occasions when the rivers flow. These are the small turtles, *Pelomedusa galeata* and others. During the dry periods they lie buried at great depths in the sand of the river beds, where they must be able to remain, on occasion, for years at a stretch.

III. GENERAL REMARKS, AND ZOOGEOGRAPHICAL SUMMARY.

The leading characteristic of the Turkana fauna, as compared with that of typical African savanna country, is the preponderance of groups dependent on animal food. Owing to the comparative scarcity of green vegetation, leaf and flower-haunting species are rare; vegetable feeders are represented mainly by the wood-boring or root-feeding groups.

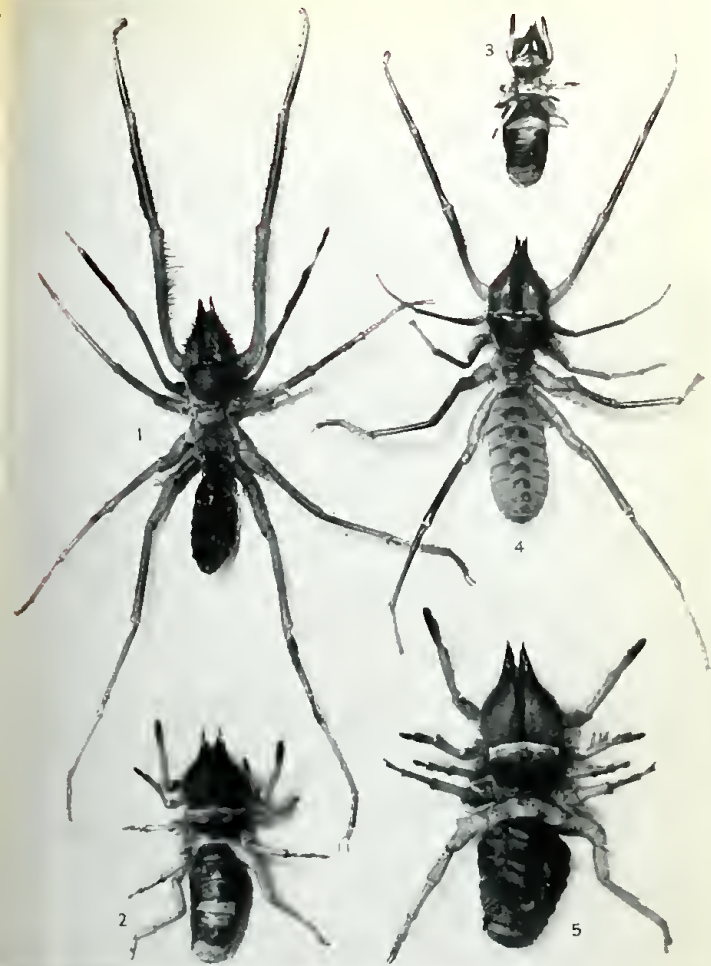
In illustration of this fact one may take the beetle. The *Carabidae* and *Cicindelidae* are active predators, both as larvae and adults; the *Meloidae* are carnivores as larvae. The *Coprinae* are uniformly dung-feeders. The common *Trox* and most of the *Tenebrionidae* probably depend on dead animal matter. The *Cerambycidae* and *Bostrychidae* have wood-boring larvae; those of the *Melolonthinae*, *Rutelinae*, *Buprestidae*, and *Elateridae* are root feeders. Families conspicuously rare are the *Cetoniinae* (Rose-chafers), *Coccinellidae* (lady-birds), *Chrysomelidae* (leaf-beetles, etc.), and *Cantharidae*—all these being foliage-haunting insects.

Among the *Hemiptera*, by far the most abundant family is that of the carnivorous *Reduviidae*, whereas in most ordinary environments these are in a small minority. Other carnivorous groups which play an unusually important part in the dry-country fauna are the Mantids and Myrmeleonids, and the Arachnid orders—scorpions, spiders, and *Solifugae*.

The Butterflies, *Hymenoptera*, and many groups of flies are poorly represented as compared with neighbouring regions; the *Pentatomidae* and other plant bugs are very scarce.

In spite of the numerous absentees mentioned and the general dry-country facies of this fauna, it is far too rich to be described as of desert character. Probably well over half the entire fauna consists of wide-spread tropical savanna species. Only two groups have been worked out from a distributional point of view—the Reptiles (with Amphibians) and the *Acridiidae* (Short-horned grass-hoppers). The

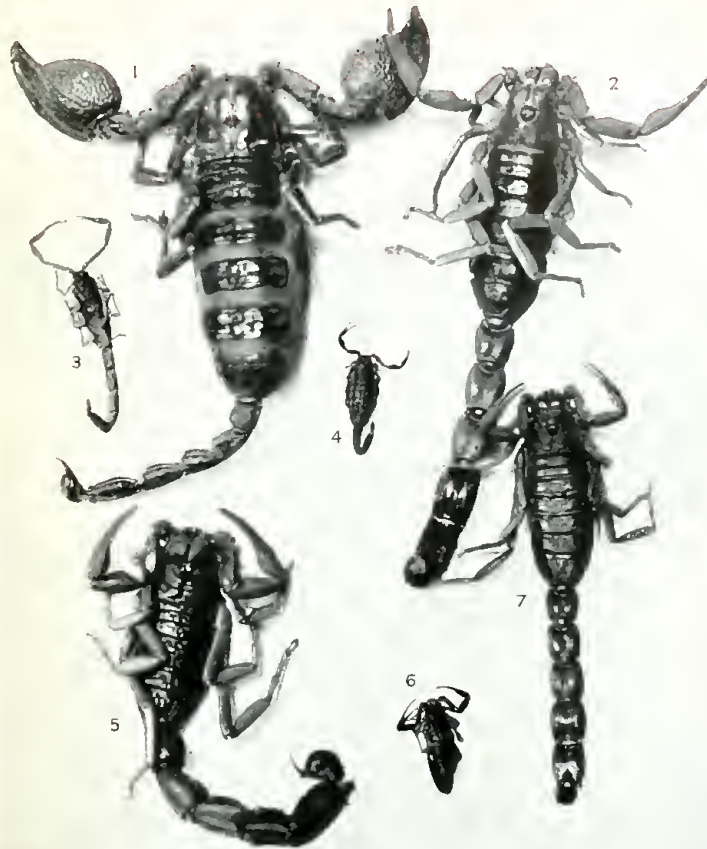




SOLIFUGAE (often called "Tarantulas")
Natural size

Highly characteristic nocturnal arachnids in Turkana. 1 and 4 are long-legged, light-bodied, swift running types; 2 and 5 are short-legged, heavy-bodied, and slow going, but very powerful.

1. *Galcodes* sp. 2 and 3. *Rhagodes* sp. 4. *Solpuga* sp. 5. *Rhagodes* sp.



SCORPIONS

Natural size

An abundant group in Turkana as in other dry regions. They come abroad at night, but are slow moving and not so often seen as the Solifugae.

1. *Pandinus* sp. 2-7. *Buthus* spp. or related genera.



FAUNA OF THE ROCK POOL AT NARAMUM
Natural size

The principal inhabitant of this pool is the frog, which belongs to the small group *Aglossa* and is entirely aquatic in all stages. The adults appear to feed on their own tadpoles, which are curious transparent creatures resembling small catfishes, swimming in shoals and living on microscopic animal life. The great water-bug (2) devours the young frogs. The snail (1) lives on the rock walls of the pool, feeding on minute green algae.

1. *Physopsis ovoidea*. 2. *Lethocerus niloticus*. 3. *Xenopus clivii*. 4 and 5. Advanced stage tadpole and newly transformed young of the same.

proportions of such widespread species in these cases are respectively 70% and 60%. The remaining species are legitimate arid or desert forms of northern or eastern derivation. There is little doubt that most of the other groups will be found to have a similar composition. Certain of the butterflies, especially the genera *Colotis*, *Herpaenia*, and *Glycestha*, and a similar small proportion of the moths, already appear to be desert forms.

Although, as has been said, the Turkana fauna is too rich for a desert, it is also too poor for a savanna. The composition of the fauna suggests, to those most competent to judge, a recently desiccated savanna, into which a certain number of desert animals have been able to penetrate as the desiccation progressed. This conclusion has been independently reached by Uvarov, on the basis of the grasshoppers, and by Parker on the basis of the reptiles. Thus Parker, comparing the reptile fauna of Somaliland with that of Turkana (which now has an essentially similar climate) finds that the latter has fewer endemic species, while the widespread African savanna forms are both better represented and less differentiated as sub-species.

These conclusions are to a great extent confirmed by much other evidence which points to the recent desiccation of Turkana. Geological and archaeological evidence show that the maximum extension of Lake Rudolf, when its level stood some 350 feet higher than now, occurred in Upper Pleistocene times, and that since then it has been sinking steadily. This presumably implies progressive desiccation, though the process was doubtless interrupted from time to time. There can be no doubt that a very much more favourable climate than now obtains existed when men of Mousterian and Aurignacian culture lived in the present area of Turkana, for one finds their implements scattered abundantly, in places now quite uninhabitable.

The Rudolf region has been known to modern geography only some fifty years, but it seems that considerable drying-up has occurred within that period. Even during the last few years serious desiccation has been experienced there, though this may mean only a temporary oscillation in climate. The level of the lake has persistently dropped, grassy plains have become desert, and cattle, once abundant in Turkana, have almost ceased to exist there.

From the zoogeographical point of view, the Turkana fauna is of mixed composition, having elements derived from several different parts of Africa. This variousness of origin is illustrated by the somewhat curious association in the Naramum pool, for here the snail, *Physopsis ovoidea*, is of South African distribution, while the frog, *Xenopus clivii*, is Abyssinian.

The derivation of the land fauna, especially of that part of it which shows a desert character, is however, a more interesting matter. Again, only the reptiles and the grasshoppers have been classified from

this point of view; but the results in the two cases are similar, and probably apply to most of the other groups as well.

Four-fifths of the reptiles of desert distribution found in Turkana belong to the Somali region. Similarly the desert grasshoppers are mostly related, some of them very closely, to Somali species. It follows that these creatures, though their ultimate origin may have been in the Sahara region, have reached Turkana not directly, but *via* the Somali country east of Ethiopia. This is indeed natural, since, as was pointed out at the beginning of this article, it is only to the east that Turkana connects with really arid country. The immigrants above mentioned were followed in modern times by another desert animal, the camel; it was introduced by human agency, by the same route, and for the same reason—the continuity of the desert habitat.

THREE NEW EAST AFRICAN MOTHS.

By W. H. T. TAMS.

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ARCTIIDAE (NOLINAE).

Nola townsendi sp.n.

Plate 1, figs. 5 and 6.

♂ and ♀. General coloration greyish shaded with fuscous. Head and thorax whitish irrorate with fuscous, and sparsely irrorate with fuscous black. Abdomen light drab. Forewing with a pattern of fuscous and whitish, irrorate with fuscous black (arranged as in figure). Hindwing light drab, faintly shaded with fuscous distally, except before termen; fuscous shading through proximal half of fringe. Underside light drab to greyish, whitish along costa of both fore- and hindwing, forewing with costa edged with fuscous along proximal half. Expanse: 18 mm.

Holotype ♂ and allotype ♀. Kenya Colony (A. L. H. Townsend). Bred. In British Museum (Nat. Hist.).

LASIOCAMPIDAE.

Chilena pelodes sp.n.

Plate 1, figs. 1 and 2.

♂. Antenna honey yellow. Palpus fuscous. Head fuscous streaked with cinnamon buff. Thorax cinnamon buff streaked with fuscous. Abdomen tergally light buff. Pectus light buff, anteriorly fuscous streaked with cinnamon buff. Legs light buff, tibiae irrorate with fuscous, forelegs strongly shaded with fuscous. Venter light buff to pinkish buff streaked with fuscous. Forewing cinnamon buff to clay; a light buff spot on discocellulars; a broad fascia from apex to middle of inner margin, lightly shaded with fuscous along its proximal edge, strongly edged with fuscous distally, the proximal three-fourths of the intervening space shaded with hair brown, the distal fourth degraded light buff. Hindwing light buff, with a cinnamon buff terminal edging. Underside of both wings light buff, a light shade of cinnamon buff along the costa of each, and around end of cell in hindwing. Expanse: 34 mm.

♀. Similar, the prevailing colour a soft hair brown, with hardly a trace of cinnamon buff in the forewing, and lacking the discocellular spot. Expanse: 40 mm.

Holotype ♂ and allotype ♀. Nakuru (A. L. H. Townsend), bred August, 1936. In British Museum (Nat. Hist.).

Leipoxais compsotes sp.n.

Plate 1, figs. 3 and 4.

♂. Antenna with shaft chocolate irrorate with light buff, pectinations honey yellow. Palpus cinnamon buff shaded ventrally with chocolate. Head, thorax, abdomen, pectus, legs, and venter vinaceous russet, irrorate or streaked with light buff, the pattern (cf. figure) picked out in fuscous. Hindwing vinaceous russet, the proximal half slightly streaked with light buff, the pattern fuscous. Underside similar, with more light buff irroration, producing a more greyish effect. Expanse: 34 mm.

♀. Similar, the colours less vivid. Expanse: 40 mm.

Holotype ♂ and allotype ♀. Kenya Colony (A. L. H. Townsend), bred. In British Museum (Nat. Hist.).

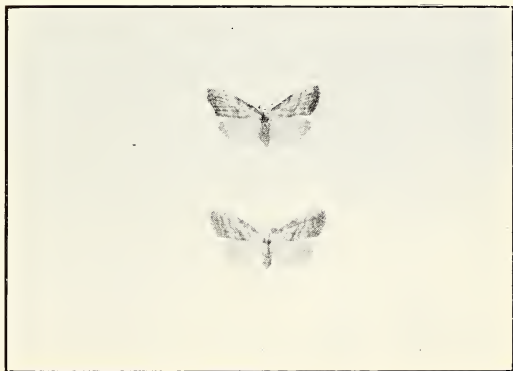
PLATE 1.



Chilena pelodes, sp.n



Leipoxais compsotes, sp.n.



Nola townsendi, sp.n.

MISCELLANEOUS NOTES ON THE EARLY STAGES OF CERTAIN HETEROCERA.

By A. L. H. TOWNSEND.

The following short notes refer to species recently bred in the Nakuru district. The food-plants have been identified for me by Dr. van Someren at the Coryndon Museum, Nairobi.

The flora of this particular district is not very diverse; but the Acacia thorn trees harbour an enormous variety of larvae (chiefly Geometrae); far more than are to be obtained on any other plant. Next in order comes Maerua ("muthigeo"), followed by the Castor-oil plant. Among the low-growing plants Oxigonum seems to be a very general pabulum. After the Geometrae, Lasiocampids and Lymantrids seem to be more numerous, or at any rate more easily obtained, than any others. The proportion of parasitised larvae among those collected, even when very young, is extremely high. It is possible that the periods given by me for the duration of the pupal state may be slightly in excess of those obtaining under natural conditions. But the error is probably not very great, since it appears that conditions of heat and cold do not affect the length of this stage so much as do those of wet and dry: and these latter conditions are comparatively easy to reproduce in the case of pupae kept under cover.

SPHINGIDAE.

Hippotion osiris, Dalm.

FOODPLANT.

Cissus jatrophioides.

OVA.

Spherical, smooth, translucent green. Laid singly on undersides of leaves.

LARVA.

After first moult has dorsal surface blue-grey, darker at root of "tail." Ventral surface the same or slightly darker. Latero-dorsal stripe yellow, and lateral area less vivid yellow, with a "frieze" of short vertical black lines, of irregular length, close together. These are interrupted by the latero-dorsal line, above which their tops again appear in the dorsal grey. Five black longitudinal stripes form a sort of collar behind the yellow head. The "eye-spot" is a black ring, with khaki central area, containing five pale blue spots. Behind it is a large black latero-dorsal spot. The "tail" is long, black, and is

switched actively backwards and forwards. Legs yellow-brown, claspers blue-grey with brown tips.

In the next instar the dorsal area from eye-spot to tail is blue-black, finely reticulated with dense black, and having a narrow central black line. Behind the "tail" it is ochreous, with black central line and other black marks. The lateral area is ochreous with black spottings and vestiges of pale diagonal stripes. Ochreous bars extend over the back from side to side. Spiracles white, each with a black mark at its lower edge. Head is red, collar bright ochreous with black stripes, of which the lateral ones extend back as far as the eye-spot. There are a pair of small pinkish latero-dorsal spots on each segment, and a thin latero-dorsal line of the same colour. Latero-ventral and ventral areas sooty-black, claspers the same. The areas mentioned above as ochreous gradually acquire a pinkish tinge, and the centre of the eye-spot becomes dark grey.

In the last instar the larva is over 4" long, and very obese. The blue-black has become blackish-grey, and the whole thing looks very much like snake-skin. It makes a large cell on ground surface, filling the spaces between leaves, etc., with very large meshed netting.

PUPA.

Is very long, grey and ochreous with black marks, and conspicuous black spiracle spots. The head is prolonged into a large narrow process shaped rather like a duck's bill.

Average duration of pupal stage is two months.

Hippotion celerio, L.

FOODPLANT.

Oxygonum atriplicifolium and several of the Vitaceae.

LARVA.

The larva of this species is too well known to need any further description. It may, however, be of interest to record the very large proportion of males to females that have emerged in those that I have bred: viz. males 25, females 2.

Basiothia medea, F.

FOODPLANT.

Pentanisia schweinfurtii.

OVA.

Smooth, green, spherical: laid singly on stem or leaves of food-plant.

LARVA.

When young, is a delicate shade of blue-green. The skin is rough. The "eye-spot" has a green centre, ringed with lemon yellow, with a black dash above and below. The next segment has a pink and white reniform spot, also with black above and below; and the following segments have a chain of pink marks, each with a 3-pointed black mark above it, and three small black dots below. The "tail" segment has a plain pink dash with a black dash above it. The "tail" is black, springing from a reddish base. The lateral area is paler green than the dorsal, and the spiracular line is paler still. Very small pustules, mostly pale, all over the body: some of those in the lateral area are black. Legs are brown, claspers blue-green.

When full-fed there is less blue in the green of the ground colour. The "eye-spot" has become very dark blue, almost black; yellow-rimmed with a black mark like a shark fin above it. Each segment has, on the latero-dorsal line, a pinkish ellipse (that on the segment next the eye-spot being somewhat reniform), each with its black "shark-fin," on which are three or more white dots. Lateral line very pale grey; spiracles white, ringed with dark grey. The lateral area is irregularly smudged with dark grey.

PUPA.

Is in a flimsy cell on ground level. Average length of pupal stage is 50 days.

ZYGAENIDAE.

Astyloneura cupreitincta, Hamp.

FOODPLANT.

Cissus jatrophioides.

LARVA.

Short, stout; when full-fed nearly $1\frac{1}{4}$ ". There appear to be two forms:

- (a) Ground colour pale yellowish-green, with a chain of maroon lozenges forming dorsal line.
- (b) Ground colour mahogany; no markings visible except that the latero-dorsal stripes are slightly darker. The remainder of this description refers to both the above forms.

There are rows of small tubercles on each segment, emitting star-clusters of short white bristles, the central ones of each star being longer. Head black, small, semi-retractile. Segment 2 black, with a pale ring on its fore side. The larva sits in the trough formed by the leaf of the food plant.

PUPA.

One was in the fold of a leaf. The rest in flimsy cocoons just at or below the ground surface. Pupation took place on June 11th, and the first imagines emerged in February. The last emerged on April 2nd. I could not establish any connection between the numbers of each of the two larval forms and of the two forms of the imago. The following are the figures of a typical batch :

| | | | | |
|-------------------------------|-----|-----|-----|----|
| Total number of larvae | ... | ... | ... | 12 |
| Number of form (a) | ... | ... | ... | 10 |
| Number of form (b) | ... | ... | ... | 2 |
| Total emergences | ... | ... | ... | 12 |
| Number without markings | ... | ... | ... | 8 |
| Number with faint markings | ... | ... | ... | 3 |
| Number with complete markings | ... | ... | ... | 1 |

The four specimens with markings were the last to emerge.

Epizygaena xanthosoma, Jord.

FOODPLANTS.

Capparis and *Gymnosporia*.

OVA.

Butter yellow, spherical, in a large deep pile on under side of leaf.

LARVA.

When full-fed is $\frac{3}{4}$ " long, slug-shaped, putty-colour with sometimes a greenish tinge. Latero-dorsal stripes conspicuous, dark brown or dark grey. Lateral stripes fainter, same colour. Ventral and anal claspers yellowish. Whole body covered with short grey-white bristles in star formation, with a few long dark bristles among them. Head dark shiny brown with whitish marks, completely retractile.

PUPA.

Is in a hard shiny yellow or white cocoon on leaf or stem. The cocoon usually shows a few of the larva's long dark bristles in its make-up.

Duration of pupal stage three weeks.

Larva is very heavily parasitised.

I have taken this insect in all stages in every month except August.

ARCTIIDAE.

Amphicallia solai, Druce.

FOODPLANT.

Crotalaria sp. (Native name "Mucingiri.")

LARVA.

When full-fed is $1\frac{3}{4}$ " to 2" long. When it is extended, is rather tapered in front. Ground colour, greenish-white, is only seen on the ventral surface, and between the segments when extended. Each segment has a golden-yellow transverse band, with an irregularly shaped black band within it. These black bands meet the irregular black lateral stripe, and (on those segments that carry claspers) extend right down to the ends of the claspers. They carry small tubercles of dark shining metallic blue (which same colour appears on the stems of the claspers) and these tubercles emit each a coarse white bristle of considerable length. There are black dots and smudges between the segments, chiefly in the lateral area. Ventral area is greenish-white, crossed by black bars. Head red, legs and claspers black. A very conspicuous larva, and a voracious eater.

PUPA.

Several pupae are spun together, in a very flimsy web. The pupa is stout, black with yellow markings, slightly hairy, polished. Cremaster of very fine hooks, and there are very fine hooks scattered all over the abdomen.

Average duration of pupal stage is three weeks.

Nola townsendi. Sp. nov. Tams.

FOODPLANT.

Lantana, sp. var.

LARVA.

$\frac{5}{8}$ " long; rather woodlouse-shaped. Apple green, with dorsal area paler. There is usually a red-brown dorsal mark, or saddle, but this varies in shape and size; being sometimes a small diamond mark on segment 7, and sometimes extending into a line of irregular width over most of the segments. The larva is strongly indented between segments, and has two small black dorsal marks on segment 2. Head small, black. A lateral tubercle on each segment emits a tuft of white bristles; there are smaller tufts of similar bristles on the latero-dorsal area, and a collar of them on segment 2. Ventral claspers (three pairs only) flesh coloured. Ventral area bright green. The larva feeds among flowers and seed heads, and is difficult to see and to dislodge.

PUPA.

Is yellowish-green, except on the dorsal area, which is reddish-brown. The abdomen is of uniform girth throughout its length as far as the terminal segment, which tapers very suddenly to a central point. It is in a very inconspicuous cocoon spun on a stem of the food-plant, or, very occasionally, on the midrib of a leaf. Average duration of pupal stage is 25 days.

The insect may be found in larval or imaginal stage in every month of the year.

SATURNIIDAE.

Bunaea alcinoe, Stoll.

FOODPLANT.

Carsonia holstii.

LARVA.

When full-fed is $3\frac{1}{4}$ " long. Ground colour black, with a ring of backward pointing spines on segments 3—12. On segment 11 the two spines in the dorsal area are combined into one central one, double tipped. These spines are all ivory-white, with the exception that on segments 3 and 4 the dorsal ones are black, and on segment 3 the latero-dorsal ones are black tipped. The lateral spines have a long white base (in shape rather like that of a rose thorn). Head black, horny: a black horny plate on segment 2. A similar black plate on segment 12; anal claspers large and horny. Spiracles orange, situated in rust-red patches. Claspers black, ventral surface black.

PUPA.

Subterranean, in a very flimsy earth cell. It is black, very strong and horny. A ridge, slightly out of centre towards the dorsal side, runs across the terminal segment, with a single central tapering point. The dorsal side of this ridge is much wrinkled, and in it are two oval holes or pits, below the base of the central point. There is a small narrow linear projection on either side in a latero-ventral position, having a serrated edge.

Average duration of pupal stage is $2\frac{1}{2}$ months.

LASIOCAMPIDAE.

Streblota diplocyma, Hamps.

FOODPLANTS.

Sodom Apple and *Gymnosporia buxifolia*. (Gikuyu name for the latter is "muthuthi.")

OVA.

Every batch of ova that I have found consists of seven, laid in a circular patch, six surrounding one. They are roughly spherical, whitish, but thickly spotted and splashed with burnt sienna.

LARVA.

The young larvae do not eat the egg shells. When first hatched they are black with yellow cross-stripes: very hairy. A later descrip-

tion is as follows : The lateral area is covered with very dense grey fur, thicker and longer on the first few segments, and pointing forwards round the face. Dorsal area dark brown, bounded by pale grey narrow stripes, and thickly marbled with pale markings on a dark ground. Above the 2nd and 3rd pairs of legs there are, in the dorsal area, transverse slits, edged and lined with short orange-tawny hair, which, when the larva is quiescent, almost disappear. But when it moves they expand and are very conspicuous. In some specimens they are almost crimson. On segment 11 the young larva has a black dorsal tuft, which disappears later. There are a series of small patches of bright violet along the central line; and on each segment, on the outside of the dorsal area, small ruby-coloured tubercles, from which spring a few long bristly hairs. On segments 11 and 12 these tubercles are sometimes black. Below the pale grey latero-dorsal line the ground colour is slightly darker grey beneath the very dense fur, and there are very short, narrow, black diagonal lines. Head dark grey, with a violet collar. There are distinct "lappets" on the sides of the thoracic segments. Ventral surface orange, with a black central line, and black cross strips between the lappets. Length of full-fed larva is $2\frac{3}{4}$ " to 3". In the last instar, and sometimes earlier in life, the fur is very strongly tinged with violet, particularly round the head. (This colour seems more marked in those larvae that feed on *Gymnosporia*.)

The young larvae sit very closely pressed to a stem of the food-plant, which is covered with a shiny deposit of silk, and looks as if varnished. The larvae are very sluggish.

PUPA.

The cocoon is papery, spindle-shaped, white, yellow, or grey. It is spun either on a stem or a thorn of the foodplant.

The average length of pupal state is 32 days. The pupa is bright brown, with very short tawny fur. Wing cases, thorax and spiracles are black, and there are three dark brown bars across the ventral side of the abdomen. The terminal segment is very much flattened at the end. No visible hooks, but two slight projections on the ventral side, with a fissure between them.

Schausinna clementsi, Schaus.

FOODPLANT.

Maerua hochnellii.

OVA.

Almost oval, but one end rather flattened and squared. Buttercup yellow, smooth but not polished. Turn apple green shortly before hatching.

LARVA.

When full-fed is $3\frac{1}{4}$ " long, very furry. Ground colour black, covered with tawny fur shading to grey, $\frac{3}{8}$ " long. The fur below the spiracular line is grey, without any tawny tinge. The most noticeable markings are an irregular series of lemon-yellow blotches on the lateral area arranged more or less in two rows, an upper and a lower. Head is dusty black, with red mouth-parts. Legs dark red. Claspers black, with a dark red patch above each. Ventral surface black, with two large yellow patches on each segment.

PUPA.

Is in a hard hairy cocoon, almost black, of blunt oval shape, attached to a stem of foodplant. Pupation took place in the first few days of August, and moths did not emerge until December 30th.

Lechriolepis leucostigma, Hamps.

FOODPLANT.

Maerua hochnelii ("Muthigeo").

OVA.

Pale butter-yellow, smooth, blunt oval; covered with grey anal fur.

LARVA.

Ground colour blackish-grey, but thickly covered with short old-gold fur. Latero-dorsal lines nearly black, fur on lateral area greyish. Each segment has a ring of blue spots, and on the dorsal surface of segment 2 is a large bifid patch of the same blue. Long greyish hairs occur sparsely all over the body. Head black, with two yellow more or less parallel crooked stripes from over the crown extending half way down the face. Ventral surface black. In the last instar the larva develops a dorsal row of thick white patches like cotton-wool, a lateral row of similar pads or patches, and another set below these, just above the bases of the ventral claspers. None of these occur on the thoracic segments. When the larva is extended, the lowest row are seen to be shaped like "eyebrows" above the claspers.

PUPA.

Is in a shuttle-shaped cocoon of heavy silk felt, on a leaf or stem. The cocoon is either white or mustard-yellow. The last abdominal segment is of blunt dome shape, and has a very large number of short curled hooks at its extremity.

Chilena pelodes, sp.n. Tams.

FOODPLANT.

Acacia thorn.

LARVA.

Length full-fed $1\frac{1}{2}$ ". Double pencil tufts, black with white tips, spring from behind the head, and are held out horizontally at right angles to the body. There is a similar double tuft, vertical, on segment 2, backed with pink, and two short pink tufts behind this. On segment 12, a dorsal tuft, black and pink, points obliquely backwards. The fur on the first three segments has a distinct pink tinge, and the lower lateral fur throughout the length of the larva is faintly pink. Legs reddish, claspers flesh-coloured with a dark streak. Head buff, striped with black. The dorsal area contains a complicated pattern of dark brown, dark blue, and white, with white latero-dorsal lines, and carries short old-gold fur down the centre. Three or more pearly-white vertical dashes in the latero-ventral area of each segment are more easily seen from below. The larva is a very quick walker, falls easily and wriggles furiously when disturbed.

PUPA.

Is in a rather flimsy whitish hairy cocoon on a stem of foodplant. Duration of pupal stage about three weeks.

Leipoxais compsotes, sp.n. Tams.

FOODPLANT.

Gymnosporia ("Muthuthi").

LARVA.

When young, has dorsal area light grey, interrupted by a black horseshoe mark near the hinder end. A dark line separates this grey from the lateral area, which is bluish with orange dots. A slight dorsal tuft on segment 11, and two very small ones on segment 3, which is slightly humped. Grey fur collar.

When full-fed, the general colour is drab, or bluish-grey. Thick grey fur on the lower lateral area points downwards (making an almost invisible joint with the stem on which the larva sits). There is an irregular grey-white dorsal stripe, wider in front. Segment 3 has two small vertical dark tufts, side by side, and segment 11 one tuft. The whole body is covered with inconspicuous orange dots and spots, and there are vestiges of short oblique lateral lines. Thick tufts of grey fur round head. Legs brown, but hidden in fur. Ventral surface has a black central stripe interrupted by orange marks.

PUPA.

Is in a fairly tough hairy cocoon, very small for the size of the larva, pupating among leaves. It is short and stout; abdomen tapering very slightly to the rounded terminal segment. Bright brown, wing-cases and spiracles darker brown. Short yellow-brown fur on

abdomen, slightly longer and thicker on head and thorax. There is a deal of very short stiff fur at the end of the terminal segment, and on its dorsal side is a patch of very many short separate hooklets.

Average duration of pupal stage is 24 days.

Anadissa affinis, Auriv.

FOODPLANT.

Acacia thorn tree, various species.

OVA.

Bright green, roughly spherical, laid in a pile covered with dark grey fur. (N.B.: In captivity the females lay infertile ova without hesitation a few hours after emergence.)

LARVA.

The young larva, when about $\frac{5}{8}$ " long, is very furry, with small black tubercles in pairs on segments 8—11, thick lateral tufts of grey-white fur. Dorsal area black, bounded on either side by a gold line, with a red-gold transverse mark on each segment. Latero-dorsal and lateral areas greyish, with paler diagonal markings. Head and segment 2 slaty-blue, with minute black spots. Ventral surface blackish. Legs and claspers black. When full-fed the length is $1\frac{1}{2}$ ". Head black, with a white mark on either side. Large dorsal tufts of black hair, backed by white, on segments 2, 6, and 12. Smaller tufts on 3, 4, and 5; pairs of very small black tufts on 7, 8, 9, and 10.

Dorsal area segments 2—6 black; 6—10 a complicated pattern of black and red, with a gold dotted line on either side, and a gold central line. This part of the dorsal area is reminiscent of an illuminated M.S. Lateral area brownish, with triangular splashes of white on most segments. White horizontal tufts below the spiracles. The larvae are semi-gregarious. Fall very easily, on a thread.

PUPA.

Is in a hard, hairy oval cocoon, of nondescript colour, spun on the stem.

Average duration of pupal stage is three weeks.

LYMANTRIDAE.

Dasychira thysanoessa, Collenette.

FOODPLANT.

Fig, both cultivated and indigenous fig trees.

OVA.

Laid in large patches of 50 or more. Spheroid, but much flattened on the upper side. Colour is light wainscot brown above, shading to almost white below. Covered with very minute reticulation.

LARVA.

The young larva is black, with long grey fur, and a black vertical tuft at either end. When full-fed length $1\frac{1}{8}$ ". Ground colour dull blackish. Segments 2, 3, 8 to 10, and 12 covered with very short old-gold fur from amongst which spring longer white hairs. Segments 4 to 7 have an extraordinary jacket of dense stiff black bristles from the spiracular line, over the back to the other spiracular line; the perimeter of this jacket being quite twice that of the parts of the body not so clothed. The black bristles are white-tipped. A brush-like tuft of the same bristles occupies the dorsal portion of segment 11. In front of the jacket are two thin pencils of long white bristles directed upwards but diverging; and behind the jacket four similar pencils spread out through a transverse semicircle. Head black, a whitish patch between jaws. From behind the head spring two pencils of fine black hairs, club-tipped; directed forwards, upwards, and outwards. Some of the white hairs on the body are nearly 1" long. Legs and claspers (four pairs ventral) flesh-coloured.

PUPA.

Is in a thick hairy cocoon, usually among leaves. The pupa is bright brown, with a thin sprinkling of pale, short fur. The terminal segment has a slight swelling on the ventral side; and the cremaster, on the dorsal side, consists of a stout tapered shank, ending in a number of fairly long-stalked hooklets. Average duration of pupal stage, two months.

(NOTE.—The males of this species "assemble" very freely.)

Lymantria (Polymona) modesta, Wkr.

FOODPLANT.

Maerua hochnelii. (Gikuyu name "Muthigeo.") More larvae are found on the very small, low-growing bushes than on the bigger ones.

LARVA.

The half-grown larva has an intricate marbled pattern of dark grey spottings on a reddish-brown ground, with fine longitudinal lines of the same red-brown. Each segment has two rather conspicuous latero-dorsal almost circular patches, slightly raised, grey-ringed, emitting dark bristles; and below the wavy red-brown latero-dorsal line are large lateral greyish tubercles emitting fairly long grey bristles. On segment 2 is a black collar, from which spring two

forward-pointing pencils of black hair. Segments 10 and 11 have each a white dorsal stud; and similar studs, but smaller and in pairs, are on segments 5, 6, 7, and 8. The fur over anal claspers is long and points backwards. Legs and claspers pink. Ventral surface yellow with dark central line. Head pale, face black.

When full-fed, length is $1\frac{1}{2}$ ", and the larva is almost uniform dark grey above, slightly paler laterally. The studs on 10 and 11 are yellow; the others have disappeared. Lateral fur-tufts are long and thick, of dusty-looking brown fur. They are quite separate from one another, and combine with the short dorsal fur in giving the larva a very wide, flat appearance from above (rather like a worn-out broom head).

PUPA.

Spun in a flimsy web among leaves. Dark brown, with a good deal of pinkish and yellow fur, and longer black fur tufts on thorax and head.

Average duration of pupal stage about four weeks.

Polymona rufifemur, Walk.

FOODPLANT.

Pepper-tree is the only foodplant I know for this species.

OVA.

Laid in a flat patch, containing thirty to fifty, either on the communal web in which the pupae are enclosed, or sometimes on bark. Very occasionally on leaves. Nearly spherical, slightly flattened, orange-pink. Very small shallow depressions all over the surface.

LARVA.

When full grown is $1\frac{1}{3}$ " long, brown, furry. A flat wide-looking larva. On each segment, two on either side of the dorsal line, are four small tubercles, the two smaller close to the centre, the two larger ones behind them and further from it. These emit thick star-clusters of very short brown bristles. The colour of all this area down to the lateral line is dark brown. The lateral line is flesh colour, with a slight pinkish tinge, and below it the colour (and that of ventral area) is pale flesh. A lateral tubercle on each segment emits a tuft of mixed long and short hairs, grey-brown, and paler hairs come from below these. The dorsal studs on segments 10 and 11 are black and inconspicuous. Head shiny black.

PUPA.

Very many of which are spun together in a messy communal web, is brown, glossy, with tufts of short tawny fur spaced out round the abdominal rings, and longer tufts on the head. Cremaster is long-stalked, and pointed, with a large number of thin curly hooks.

Laelia hemippa, Swinh. (Subsp. nov.?)

FOODPLANT.

Acacia thorn tree.

LARVA.

Length 1" to 1 $\frac{1}{4}$ ". Four brush-tufts, tawny yellow, with black bases, spring from a black dorsal area. Behind these, yellow dorsal spots interrupt a grey transverse ring on each segment. Two dark pencil-tufts point forwards from segment 2, and there is a canary-yellow dorsal tuft, backed with dark hair, on segment 12, on which segment there is also a white lateral mark. The lateral tubercles emit stars of whitish-grey hair, while the longer bristles on dorsal and latero-dorsal parts are black. (In the young larva the lateral fur on segments 3, 4, and 5 is canary-yellow.) Head, legs, and claspers red. The larvae run very rapidly, and are obtainable in most months.

PUPA.

Is in a loose cocoon of nondescript colour, usually among stems and leaves, but sometimes on ground surface. In the latter case the silk is mixed with earth, and the cocoon attached to the trunk of the tree.

The pupa is bright brown with a good deal of yellowish fur. Cremaster is on a long conical base and consists of a large number of hooklets which all converge to a point.

Duration of pupal stage about three weeks.

NOTODONTIDAE.

Thaumtopoea apologetica, Strand.

FOODPLANTS.

Maerua ("Muthigeo") and pepper-tree.

OVA.

In a patch about 1 $\frac{1}{2}$ " long, glued to the stem of foodplant, thickly covered with the tawny anal fur of the female.

LARVA.

The young larva is yellow, with long white hairs springing from black warts. Head black, and a black plate on segment 2. When full-fed it is 1 $\frac{1}{4}$ " long with very dense long white fur. Head black, with a few short bristles. Dorsal area pale green. Immediately behind the head is a shiny black half-collar. Segments 3 and 4 have a ring of small black dots. Segments 5 to 12 have, besides the ring of dots, a large central black patch, rather humped or cushioned. A thin broken black line separates the green of the dorsal area from the

yellow colour of the sides. Ventral surface pink flesh colour. Legs black, claspers yellow-green, anal claspers black. Description is rather difficult since the whole larva is clothed in a dense mass of silky white hair.

The young larvae sometimes live in a web, but are more often in a group, quite openly, on a leaf. When older they form large conspicuous silky balls at or near the ends of the branches. Their moults usually take place in a web, sometimes on the ground surface, mixed up with dead leaves, earth, grass, etc. Moulting process is sometimes prolonged into six days. The processionary habits of these larvae are well known.

PUPA.

The pupae are subterranean, in a ball of earth and felt, as large as a tennis ball. The cocoons, dark grey, Zeppelin-shaped, are packed as close together as possible in this ball.

Emergence seems very irregular. One batch, which went down on July 24th, produced imagines from December 12th until May 5th, the greater number emerging between February and May. Other batches have emerged in three months.

NOCTUIDAE. HADENINAE.

Cetola pulchra, B. Bak.

FOODPLANT.

Lantana.

LARVA.

When young is superficially like a young larva of *P. demodocus*. Its length when full fed is $1\frac{1}{2}$ ", and it is very stout. The fore end is much thicker than the hind end, and the body is very much humped up between legs and claspers. Ground colour dark brown, with two large splashes of dirty white, the first on segments 2, 3, and 4, the second on segment 12. The former is an irregular dorsal splash, roughly double-diamond shape; the latter extends over the back down to the spiracular line, and forwards in the lateral area to enclose two spiracles. At the highest part of the forward hump is a dirty-ochreous transverse fold, or ridge; and the four tubercles in its neighbourhood are of the same colour. The body is covered with brown and black tubercles of varying sizes, larger on the humped parts; and there are faint diamond marks, outlined in white, forming a dorsal line between the two white splashes.

Head large, black. Legs black. Ventral claspers paler (four pairs, but the first pair little used). Ventral surface dark grey. The larva mimics a bird-dropping, and is a most unpleasant looking insect, with a wet, oily appearance. Just before pupation all the marks mentioned above as "white" turn to deep orange-buff.

PUPA.

Is in a cocoon made of earth mixed with a deal of glutinous stuff, very hard, and smooth outside like dried mud. Among leaves on ground, or occasionally fixed to a stem at ground level.

The pupal stage lasts for $2\frac{1}{2}$ months or more.

The terminal segment of the pupa ends in a small dome, rather flattened on the ventral side; the cremaster appears to consist of two very short points at the extremity of this dome.

EUTELIANAE.

Eutelia adulatrix, Hubn.

FOODPLANT.

Maerua ("Muthigeo").

LARVA.

Stout, smooth-skinned, tapers considerably from front to back. Light apple-green, with white or yellow latero-dorsal lines joined by fainter cross-lines of the same colour at each segment, making a "ladder" effect. These cross lines are carried on, less distinctly, to the faint lateral lines. As it grows to maturity the dorsal cross lines become much less distinct; and in the final instar the whole body is covered with faint white dots, thicker on the dorsal area, so that its colour becomes whitish or greyish-green, with a slightly granulated appearance. The spiracles are red; head and claspers paler than ground colour. Occasionally the cross lines vanish altogether except one on the ridge formed by the withdrawal of the retractile head and second segment. The other markings then are four yellow longitudinal lines, the latero-dorsal ones meeting over the anal claspers; the laterals not extending the full length of the body. The larva lies along the mid rib on the under side of a leaf, or sometimes at the edge. In either case it is extremely difficult to detect. It is very much subject to a parasitic fly.

PUPA.

Is underground, in a very close fitting cell. It is black, or very dark brown. The terminal segment is a blunt dome, highly polished, with no visible cremaster. Duration of pupal stage is about two months.

PHYTOMETRINAE.

Plusia tranfixa, Walk.

FOODPLANT.

Vernonia sp.

LARVA.

1 $\frac{1}{4}$ " long, tapering very much in front, slightly humped behind. The central green colour of the dorsal area is edged by a white line. Latero-dorsal area green, with three or more very fine white lines in it. A slightly darker green area occurs just above the white (or sometimes yellow) spiracular line. Ventral surface green. Head very small, vivid translucent green, with dusky marks on cheeks and forehead. Ventral claspers (2 pairs) green. A few scattered short colourless bristles scattered over the body. The larva usually stands with its fore part raised from the plant. It falls very readily.

PUPA.

In a thin cocoon on stem among leaves, or on ground surface. Pupa is at first brown, with yellow abdominal rings; later, uniform black. Average duration of pupal stage 3 $\frac{1}{2}$ weeks.

CUCULLINAE.

Empusada argentivitta, Hamp.

FOODPLANT.

Vernonia.

LARVA.

When young, dark green, with vivid white lateral stripe, and white dorsal dots on each segment. When full-fed length 2". Wide dorsal stripe of slate-grey, with a rusty-pink central line. In some cases, in the last instar, this rust colour covers almost the whole width of the dorsal area. In this area each segment has four white dots, arranged in a square (except on segments 2, 3, and 4, where they form a transverse ring). Below the dorsal area is a wide green stripe, with a yellowish upper edge. Below it a vivid white stripe. The whole dorsal area and the green stripe carry a mass of very fine black longitudinal lines. Ventral surface and claspers dull green; head and legs yellowish-red. Spiracles white. Skin smooth and rather polished.

The young larva when annoyed strikes out with its head. When older it rolls up and falls very easily. It eats both leaves and flowers. It is very much subject to a parasitic fly.

PUPA.

Is usually among leaves and rubbish on ground surface but in two cases I found them in earth cocoons below ground.

Average duration of pupal stage 2 $\frac{1}{2}$ months.

ACRONICTINAE.

Magusa versicolora, Saalm.

FOODPLANT.

Cassia didymobotrya.

LARVA.

When full-fed is nearly $1\frac{1}{2}$ " long, stout, smooth-skinned, with segment 12 slightly humped. Ground colour dull light green, but with a great many stripes and lines. There is a dorsal central bright yellow stripe, with one of ground colour on either side. A narrow white line separates this from a further stripe of green, which itself has a thread-like white line in its centre. Next, a broader white stripe, followed by a black one of the same width. (This last usually disappears in the final instar.) The black one has faint signs of a white central line, and below it is another thin white line. The spiracles, black ringed, lie in a broad yellow stripe, with black and green spots on its upper edge. Below the spiracular stripe the green ground colour appears again, with a tiny darker dot on each segment. At the base of the claspers is a thin rather broken white line. Most of these lines and stripes converge on the hump, which has white patches on its dorsal surface. Ventral surface ground colour, claspers the same, with reddish extremities. Legs pale green. The pale green head and segment 2 have several black dots. The larva sits extended on a leaf. It is sluggish, and very much subject to attacks by a small ichneumon.

PUPA.

Subterranean.

Average duration of pupal stage five weeks.

Brithys pancratii, Cyr.

FOODPLANTS.

Crinum kirkii (*Amaryllidaceae*) and cultivated *Amaryllis* lilies.

LARVA.

Length when full-fed is $1\frac{1}{3}$ ", tapers slightly towards either end. Head reddish-yellow with black spots, claspers same colour as head. Ground colour pale yellow, with deeper yellow lines dividing the segments, and four narrow black longitudinal stripes. Round each segment runs a broad irregular transverse band, dark brown to black; and the effect of these, together with the longitudinal lines, is to give a network appearance of pale yellow, more or less circular, spots with dark edging. There are inconspicuous small shiny black tubercles scattered over the body, emitting bristles; the greater number of these tubercles being disposed in double transverse rows on the black bands. Anal segment about the same colour as the head, with raised black spots.

PUPA.

Naked, dark brown, in a very flimsy subterranean cell. Cre-master has only two very short points, widely separated, on the dorsal side of the terminal segment.

Duration of pupal stage is about one month.

OPHIDERINAE.

Sphingomorpha chlorea, Cram.

FOODPLANT.

Acacia thorn tree.

LARVA.

When young 1" long, slender, very dark dirty green, lighter on the humped-up and slightly swollen portion between legs and claspers. A sharply defined grey dorsal stripe from anal claspers more than half way up the body; then a gap of green, and the grey again over the front two segments and head. Under a lens the whole body shows very fine marblings of very dark colour. Black latero-dorsal spots become small raised tubercles on the last few segments. A few short scattered bristles, chiefly on the lateral area. Two pairs of white dots on top of head. Face grey, with dark lines. Palpi prominent.

When full-fed, larva is $2\frac{3}{4}$ " long, dark velvety brown. There is one very conspicuous dorsal patch (between legs and claspers), orange, with black sides. Shortly before pupation this patch becomes vivid scarlet. On the next segment is a smaller patch, lemon yellow. These patches are so hidden in the folds of the skin that they are only visible when the larva moves, and is extended. Dorsal stripe irregular, reddish brown, with small twin tubercles on segment 11, and smaller ones on 10 and 12. Very small white dots in pairs, lateral and latero-dorsal, on most segments. Head velvety black, face brown. Ventral claspers pale, four pairs, but the first pair rarely used. A few pale bristles scattered over the body. Ventral surface pale, with wide central black stripe. Legs brown, spiracles red-brown. A few brownish-yellow spots behind head. The larva is sluggish, but once aroused has a great turn of speed, its motion including a sort of half looping action.

PUPA.

Subterranean. Duration of pupal stage two months.

Audea fatilega, Feld.

FOODPLANT.

Acacia thorn tree.

LARVA.

Length when full-fed $2\frac{1}{4}$ ". Ground colour dun, with a dark reddish tinge on the dorsal area of each segment. Body very much flattened below, so that it lies very closely pressed to stem of food-plant. Head large, with thin neck; its colour the same as that of the body, but it has two pale "eyebrow" marks, with black "eyes" below them. A pair of brown dorsal protuberances on segment 11, smaller and darker pairs on 9 and 12, and rows of very small ones along the latero-dorsal lines. Dorsal line is faint, paler than ground colour, with a fine black line each side of it. Short pale bristles, pointing downwards, below the spiracular line. Ventral claspers, four pairs, but the front pair are little used, so that the larva half-loops when walking. The claspers are paler than the ground colour. The larva is difficult to see, and very sluggish; but when once aroused it runs at terrific speed, with a curious centipede-like motion.

PUPA.

Is in a strongly constructed cocoon plastered all over with the acacia leaves, and anchored to two or three leaf-stalks. Duration of pupal stage is about three weeks.

ERASTRINAE.

Eublemma chlorochroa, Hmpsn.

FOODPLANT.

"Sodom Apple" (*Solanum*).

LARVA.

Length 1" to $1\frac{1}{4}$ ", stout. Greenish putty-colour, strongly indented between segments. Only two pairs of ventral claspers developed. There are transverse rings of pale tubercles, set obliquely in pairs, joined by brownish longitudinal lines, giving a sort of chain effect. These tubercles emit a few straggling bristles. Head black, very small. A black plate on segment 2, with three light lines on it.

The young larva lives in a nearly transparent brownish "cocoon" on the underside of a leaf. Later it pulls together the point of a leaf and lives in the retreat so formed.

PUPA.

The pupa is either in the larval home as above, or sometimes in a cocoon fastened to the stem on the earth surface.

The pupal stage usually lasts about 35 days, but in three cases it was prolonged to over nine months.

Tathorrhyncus exsiccata, Led.

FOODPLANT.

Indigophora, various species.

LARVA.

A very active looper, with two fully developed pairs of ventral claspers, and a third (in front) rudimentary. The full-fed larva is $1\frac{1}{4}$ " long, tapering to either end, very slender. Ground colour reddish ochreous, but the whole body is covered with a mass of fine dark longitudinal lines. These lines thicken to form latero-dorsal stripes, with a slight "splotch" on each segment. Spiracular line is black. Head grey, but with many fine dark lines. Palpi long and prominent, grey-white.

The larva is almost invisible on its foodplant. It sits closely pressed to a stem, with legs and palpi held forward. It does not fall easily, but when it does, it remains rolled up on the ground for a very long time.

PUPA.

The red pupa is enclosed in a loose silk-and-earth cocoon on ground surface.

Average length of pupal stage is 25 days.

Chalciope hyppasia, Cram.

FOODPLANT.

Indigophora sp. var.

LARVA.

In general appearance and habits, as in food, this larva much resembles those of *Tathorrhyncus*. But it has only two pairs of ventral claspers, without any vestiges of a third pair. When full-fed it is $2\frac{1}{4}$ " long, and stout. The description of a full-fed larva is as follows: The whole body is a mass of fine dark longitudinal lines. Dorsal area is ochreous, sharply divided from the grey lateral area. There are smoky smudges on the dorsal part of the central segments, and a fairly distinct central stripe, more noticeable at either end, where the area on either side of it is darker. Two small latero-dorsal black spots on the five central segments. Lateral area grey with a faint pink and white narrow stripe along its lower edge. The ventral area is a much darker grey, with a central stripe almost black. The stems of the ventral claspers are the same colour as the ventral area. There is no sign of a third pair of ventral claspers. Head is a mass of black and white lines, and has small black dots on crown and sides. A few short bristles, mainly around head and anal segment. When the larva is "looped," there are distinct dark grey divisions between the segments of the central portion. The larva's colour gets lighter with age, and when it is full-fed the whole body is a sort of ashen grey, except for the dorsal area (which remains ochreous) and the black ventral stripe.

PUPA.

Is in a rather flimsy cocoon among the stems just above the surface of the ground. It is brown, covered with a grey bloom. The last abdominal segment is truncated, and the cremaster is a nearly semi-circular plate, situated on the dorsal side, fluted on the outside edge, with a large number of separate short hooklets distributed over the surface of the plate.

Duration of the pupal stage is seven weeks.

GEOMETRIDAE (GEOMETRINAE).

Osteodes procidata forma *turbulentata*, Guen.

FOODPLANT.

Acacia thorn tree.

OVA.

Laid on May 5th. Some on the edges of leaves, but most on the leaf-buds. Bluish-green, short oval. Very small for the size of the moth. They hatched on May 13th.

LARVA.

Young larvae ate shells and moulted. Green with black lateral and latero-dorsal spots, and a yellowish lateral line.

On May 31st, about $\frac{3}{4}$ " long, ground colour now ochreous, either reddish or brownish, retaining the yellow lateral line as a series of crescent marks. Slight latero-dorsal tubercles appearing. Later the larva's ground colour is various shades of ochreous, grey, or bright brown in different specimens. The segments are "bulgy," with lateral and latero-dorsal tubercles more marked. In most cases there is a dorsal pattern consisting of a black broad-arrow behind the head followed by pairs of short narrow parallel black dashes, usually indistinct or absent on the central segments. A very variable larva for so unvariable a moth. Length of full-fed larva is $1\frac{1}{4}$ ".

PUPA.

(June 21) is just underground in a very flimsy web-cocoon. Average duration of pupal stage is 24 days.

Coenina aurivena, Butlr.

FOODPLANTS.

Various; perhaps the favourite is Lantana.

LARVA.

When young is uniform purple-brown. When full-fed it is nearly 2" long. Ground colour grey, with a slightly pinkish tinge.

The most prominent feature is a pair of latero-dorsal tubercles on segment 6, Indian-club shaped, white with black spots. Very small latero-dorsal tubercles on segments 5, 7, 8, and 12. Head small, ground-colour with black spots. Mouth-parts and palpi yellow. Various black spots on the lateral area of all segments, and on the dorsal area of segment 3. Lateral wrinkle lighter than ground colour, and latero-dorsal lines the same, but faint. Triple black lateral dashes on 7, 8, and 9, of which the uppermost is the largest. Legs black and white ringed.

This larva varies considerably. In some specimens there is a large amount of orange—orange tips to the clubs, and orange spottings in the spiracular area and on the claspers. Occasionally there is a double pink interrupted dorsal line, and a black dorsal dash on segment 2.

PUPA.

Is in a tough cocoon among leaves. Average duration of pupal stage about two months.

Lomographa eridata, Warr.

FOODPLANT.

Acacia thorn tree.

LARVA.

When full-fed is $\frac{7}{8}$ " long, slightly flattened, sharply pointed behind. Dull pale green, with a rather greyish tinge. The skin appears granulated, an effect which a lens shows to be caused by small transverse corrugations that give all the longitudinal lines a serrated appearance. Four white raised transverse lines over the back join the strong white lateral lines, or wrinkles, which meet one another at the anal point, and have slight reddish spots throughout their length. There is a very faint double white dorsal line, stronger on segment 2. Ventral surface darker green, with faint yellow divisions between the segments. Head narrow, high-crowned, bifid; tips of lobes yellowish. Claspers yellowish.

PUPA.

Black, in a small cocoon among leaves. Cremaster on a long tapered stalk, inserted on the dorsal side, and terminating in two diverging branched hooks.

Zamarada ochrata, Walk.

FOODPLANT.

Acacia thorn tree.

OVA.

Are laid among the leaf-buds, or on the edges of the leaflets. They are dull green with a slightly bluish tinge, long oval, but slightly tapered to one end. They are covered with lengthwise rows, close together, of minute oval depressions. On the 12th day they turned dark grey and hatched on the 13th day.

LARVA.

The young larva is green with a pronounced blackish lateral stripe. When full-fed it is $\frac{7}{8}$ " long, fairly stout. Ground-colour bluish dull green, paler on the ventral surface. Six or more diagonal lines, yellow with a red forward edge, start from the centre of the dorsum and extend downwards and forwards to the lateral line. This line, which meets its fellow at a red spot in a triangular projection above the anal claspers, is yellow with red spots. Below it the above-mentioned diagonals are carried on to the centre of the ventral area, but have no red edge, and are paler than the part of them above the lateral line. Head square, green with two red-yellow marks on crown. Legs and claspers green.

PUPA.

Brown, in a tight cocoon among leaves of foodplant. Cremaster has eight or more thin brown curly hooks. Most of these spring from the tip of a large cone on the dorsal side of the segment, but a few are placed higher up the cone.

Duration of pupal stage is three weeks.

HEMITHEINAE.

Omphacodes pulchrisfimbria, Warr.

FOODPLANT.

Acacia thorn.

LARVA.

When full-fed is $1\frac{1}{4}$ " or more. Very slender, stouter at rear end, but tapering all the way to the head. Very inconspicuous, being extremely like the mid-rib of a leaf. Ground-colour pale yellowish-green, with very few markings. In some specimens there are hardly any at all. The following description is from a heavily marked larva. Head deeply bifid, the points of lobes being dark brown. Two small pointed dorsal tubercles on segment 2, also brown. A small dark dorsal spot at each joint, these spots being joined by a thin indistinct dark line. A red lateral mark just behind each segment-joint, with an elongated brownish smudge behind it, in which smudges are the spiracles. The first and second smudges are slightly swollen. Below the smudges is a pale longitudinal line. Two brown spines project

over the anal claspers. Ventral claspers have a streak of reddish brown, and there are two lateral dots of the same colour between them and the anal claspers.

PUPA.

Loosely spun up among leaves, has a pale yellow abdomen, pale green wing cases. Cremaster has eight long curled hooks, springing from a fluted, tapering stalk. Average duration of pupal stage is 19 days.

STERRHINAE.

Rhodometra sacraria, Linn.

FOODPLANT.

Oxygonum atriplicifolium.

OVA.

When first laid are pale yellow, but in twenty-four hours they turn to carmine. They are long oval in shape, and are fastened to the ends of the bristles at the joints of the stem. A few however were attached to the edge of a leaf. After ten days the ova turned silver-grey, and hatched on the eleventh day.

LARVA.

The young larvae did not eat the egg-shells. They grew very fast, and in just over a week had reached a length of almost 1". At this time the dorsal area was brown, with pale central and other lines in it. It is bordered on the lower edge by a darker brown line which is continued along the side of the head. Below this is an almost white lateral stripe. Ventral area greenish grey. At the joints of segments there is a small white dorsal spot (but not on the first few segments). There is another form in which the ground colour is green. In the final instar the ground colour is very variable; from rose red through golden brown to stone grey.

PUPA.

Is very slender, usually green, sometimes buff, in a flimsy web among leaves. Average duration of pupal stage 19 days.

Sterrha intervenata.

FOODPLANT.

Oxygonum atriplicifolium.

OVA.

Are deposited on the bristles at the joints of foodplant, or occasionally on the edges of leaves. They are oval, yellow when first laid, turning in twenty-four hours to rosy carmine. They hatched on the 12th day, having previously turned grey.

LARVA.

When half-grown has ground colour light brown, with a pronounced white lateral wrinkle, below which, and on ventral surface it is grey. The whole body has many fine dark longitudinal lines. In the centre of dorsal area is a sort of chain of short white streaks; and the spiracles appear as minute black dots. A dark line starting at side of head extends as far as the first of these. The larva stands erect on the edge of a leaf, and often keeps up a violent side to side vibration for long periods. When full-grown the larva is usually green, with an interrupted red dorsal stripe having a chain of white marks in its centre. (In some specimens this chain takes the form of a white cross at each segment-joint, having a dark spot behind its centre.) The dorsal stripe thickens and darkens towards the anal claspers. The ventral area is much paler, grey-green, and the green shades to a darker colour as it goes upwards. The latero-dorsal area is quite a dark green. Head red, with paler mouth parts, and whitish lines. Claspers red; a whitish streak on the anal ones. A less common form of the full-fed larva has ground colour dark brown (with the usual chain of white dorsal marks); ventral surface grey.

PUPA.

Spun loosely among leaves, is slender, pale green or yellow, with black lines defining antennae, wing venation, etc. There are two black dorsal streaks on the thoracic segments, and a faint dorsal line on abdomen, with black spots on either side of it. Also black lateral spots. Pupal stage lasts three weeks.

BREEDING HABITS OF THE CRESTED WATTLED PLOVER (*SARCIOPHORUS TECTUS LATIFRONS*)

By M. E. W. NORTH, M.B.O.U.

HAUNTS, DISTRIBUTION, AND FIELD CHARACTERS.

From September 1935 till August 1936 I was District Officer at Garisa (Northern Frontier District). Here I discovered that the Crested Wattled Plover¹ (*Sarciophorus tectus latifrons*) was a common breeding species, although it had not previously been reported as nesting in East Africa. So I was given the chance to make a careful study of its breeding habits, and found them both interesting and unusual.

The notes that follow can be taken as a supplement to Dr. V. G. L. van Someren's article on this species in his "Birds of Kenya and Uganda" in the Journal of this Society² for October 1933, page 21. This deals with plumage, distribution, and habits other than breeding. van Someren records two forms of this species as present in Kenya—*Sarciophorus tectus tectus* and *Sarciophorus tectus latifrons*. He states that the former ranges from Turkana and South Rudolf across to the Northern Frontier District, and the latter from the Juba River to the Tana and to South Ukambani. As Garisa is on the Tana (39° 45' E. 0° 30' S.) I expected to find *Latifrons* there. Since all the birds that I saw had the broad white patch on the forehead that distinguishes *Latifrons* from *Tectus* I was almost certain that the race at Garisa was *Latifrons*, and therefore collected only a couple of specimens. These van Someren has kindly compared with his own large series, and he is satisfied that my specimens are *Latifrons*.

I was able to obtain only a rough idea of the distribution of the bird in the 25,000 square miles of Garisa district. The north-west limit seems to be at Saka, where the Tana makes its great bend from east to south. Above here, though the country seems suitable, I have not seen a single bird, nor have I noted any on the Galana Gof at Benane or Muddo Gashi, or intermediately between these places and the Tana. North and east of Saka, however—between the Tana and the Uaso—the bird is to be found, and I have seen it east and south-east of Garisa in the Kurde and Rama areas near the Italian boundary. Along the Tana from Saka south to Garisa (35 miles), it is plentiful, as from Garisa to Bura. Bura is 50 miles south of Garisa, and is where the main road leaves the Tana and bears south-east to Lamu (120 miles). I have not been beyond Bura.

¹Called the "Smaller Blackhead Plover" in the *Systema Avium Aethiopicarum*.

²Subsequently referred to as "Journal."

Garisa district is, I think, typical country for the Crested Wattled Plover. It is part of the huge low-lying plain of the Northern Frontier, never more than a few hundred feet above sea level, perfectly flat, and covered with thorn-scrub. The rainfall is both irregular and patchy, the seasons when rain is expected (though by no means always obtained) being April and November. The climate is warm, mid-day shade temperatures varying from 75°F. in the cool season to about 100° in the hot, the average being well over 80°. The river Tana cuts south through the desert, its forested banks proving a welcome relief from the monotony of the thorn-scrub. The Tana, the Uaso, and a few water-holes on the Galana Gof are the only places in the district where permanent water may be relied on, although in the desert there are numerous pools which may or may not be filled in the rains. In the dry season all but a few of these will certainly be empty. After good rains both water and grazing are to be found all over the desert, and the Somali with his herds of cattle and goats, the wild game, and many species of birds such as duck, waders, and herons all go out and colonize these areas until the grass withers and the pools dry up, and it becomes necessary to return to the safety of the permanent waters. Thus a marked seasonal migration is a normal feature of human, animal and bird life in the district.

As a bird of the dry sandy country, the Crested Wattled Plover is not, however, particularly subjected to these rain-induced movements. It may usually be found in an open sandy place in the bush with scattered grassy patches. Often a river or water-hole is not far away, and the birds seem to be partial to the vicinity of human dwellings. I have never seen them frequenting the actual muddy margins of swamps like other waders do; they are always on the hard ground a little distance off. The haunts of this bird thus correspond with those of the race *Tectus* in Nigeria and Gambia described in Mr. D. A. Bannerman's "Birds of West Africa," Vol. II, page 120. At Garisa it feeds in the sandy patches or among the short grass, and the stomachs of the specimens I shot contained numbers of tiny, whitish, hard-shelled insects. I have seen the bird right out in the bush, at least twenty miles from open water. Usually, however, it is in green surroundings, e.g. near a dried-up swamp. The really arid places do not seem to be patronised.

The field characters of this plover are shown to a certain extent in the photographs. It is about eleven inches in length, with a short compact body and long red legs, and a conspicuous black crest. Encircling the neck and running down the centre of the breast is a wide black band, like a muffler. This is separated from the black on the head by a white band, widest at the chin and at the nape. The forehead is white, but the lower part is obscured by two red wattles which grow in front of each eye and together make a continuous red band across. The back is brown, and the underparts mainly white. In

flight the wings (which are pointed) show longitudinal bands of brown, white and black, and the black tail with white coverts is conspicuous. I was not able to distinguish between the sexes in the field, though it might be possible to do so with more experience. All the birds were very much alike, but some had longer crests than others. These may be males. My two skins are male and female. There is not much difference in size, but the crest of the male is much the longer, and the bill longer and heavier (♂ 28 mm., ♀ 25). There may be a difference in the calls, but again I am uncertain.

I have little to add to the notes made by other observers on the habits of this bird in the non-breeding season (e.g. by Mr. G. L. Bates in his "Handbook of the Birds of West Africa," page 42, and by Rear-Admiral H. Lynes in the *Ibis* for 1925, page 568; and particularly the descriptions in Bannerman's and van Someren's works already mentioned).

BREEDING HABITS.

Outside East Africa the nest of *Sarciophorus* has been found occasionally, e.g. by Lynes in bare open country in Darfur (Sudan), and by Mr. J. B. Welman on the polo ground at Maidugari in Nigeria (Bannerman, page 121). Bannerman mentions a clutch in the Nehrkhorn collection, the two eggs measuring 35 x 25 and 37 x 25 mm. These records however are all for the race *Tectus*; I think that the eggs of *Latifrons* have never been described. They are not represented at the Coryndon Museum, nor, I believe, at South Kensington, nor (according to articles in the *Oologist* some years ago) in the Nehrkhorn collection or in those of certain other collectors who have specialized on the *Charadriidae*. I cannot find any reference to them in the *Ibis* or in other journals or papers. So when I found that *Latifrons* was a common breeding species at Garisa I resolved to avail myself fully of the opportunity thus offered. Photographs had to be taken of the bird itself and of its nest, eggs, and young; sufficient clutches of eggs had to be collected for the Museums, and a few skins of breeding birds obtained to verify their identification; observations had to be recorded on the various stages of breeding. In the achievement of the first two objectives I was fairly successful; in the third I did as much as circumstances would allow. Where desirable I have shortly referred to similar or comparable habits in other members of the *Charadriidae* which have been noted by other observers.

I do not think for one minute that the nesting of this bird is new in the sense that it has not previously bred here; no doubt it has done so for many years, escaping notice merely because the fact was not reported. Mr. R. G. Darroch, District Commissioner at Garisa, tells me that he found young when at Bura in 1930, and that the bird has been common as long as he has known this area.

The place where I knew the bird best was in the immediate vicinity of the station itself. This is situated on the east side of the Tana, at a point where the banks are high and the belt of forest very narrow. The officers' houses are within a few yards of the river. For a short distance from the bank there is alluvial soil, the product of big floods in the past, and here there are gardens and large forest trees. Almost at once, however, the alluvium yields to sand, and the vegetation changes to the thorn bushes and acacias which cover so much of the district. The office and guard room are on the fringe of the hard soil, and so is the village, a couple of hundred yards away from the river. From the village the main road runs north, parallel with the Tana but some distance from it. Two miles away there is a large cleared space—the landing ground—which is the main breeding haunt of this plover. It is a circle eight hundred yards in diameter, all on hard sand except for the very lowest end which touches the belt of alluvium. The latter is much wider here than at Garisa, as is the belt of forest, which, with its Dom Palms, Tana Poplars, Wild Figs and other large trees, rises like a wall in the distance. The thorn-scrub entirely encircles the landing ground, which is an exceptionally large open space for this part of the district.

The breeding season in 1936 was after the April rains. There were five nests with eggs on April 28th, and many others were discovered during the first half of May. This would seem to have been the height of the season. More were found at the end of the month, and one as late as June 25th. The first nest with young was found on May 6th.

The nest is a scrape in the sand, in which two eggs are laid. The most popular nesting area was a portion of the landing ground where there was hard firm sand in places, and short grass and debris in others. Here at one period there were seven nests within three hundred yards. The favoured locality happened to be just where the road crossed the landing ground; anywhere else the birds would have led a much quieter life. However they did not seem to object to disturbance, as was made clear by the number of nests found in the most unexpected places in and around the station itself. One was beside a much-frequented path and within a hundred yards of the guard room. Another was on alluvial soil near the garden, and yet another hidden in short grass within a stone's throw of the dressing station. Perhaps the most remarkable of all was at Saka, near the rest hut. This is perched on a bluff above the river, sufficient forest having been cut away for the building and its sandy compound, and no more. Yet a bird chose to nest there, within thirty yards of the hut, and in full view of myself when conferring with the local headmen! What I imagined to be the normal type of breeding area was in the vicinity of a large Somali man-yatta near Garisa. Here the birds nested in the thorn bush, in which an opening ten yards square seemed quite sufficient. In most of the

district they would be obliged to use this type of country. Of twenty nests discovered, ten were out in the open, and ten in more enclosed country. Eighteen were on hard sand and two on the river loam¹.

All through the breeding season some birds near my house at Garisa had the peculiar habit of mobbing me every time I passed, although I knew they had not got eggs or young. As I approached, they would watch me nervously, uttering their harsh cry, "Kwairr . . . kwairr." When I was near the noise would get shriller, "Kiarr . . . kiarr," then the birds would take to flight with a piercing "Kir . . . kir . . . kir," racing over my head and diving at me furiously. Then suddenly their wrath would evaporate, and they would alight only a few yards away, modifying their call again to the first note, "Kwairr . . . kwairr." I have seen these birds wheeling, diving, and tearing along close to the ground in a manner very similar to the Lapwing (*Vanellus vanellus*). Generally speaking, in a place where some birds have eggs and others have not, it is the latter who perform the sentry duties. Mobbing intruders is, however, by no means confined to the breeding season; birds may do so at any time of year. Capt. C. D. Priest has noted the same aggressive characteristics in the South African Wattled Plover (*Afribyx senegallus lateralis*; "Birds of Southern Rhodesia," Vol. II, page 98).

A bird breeding in such exposed places either has to run off the eggs as soon as danger is sighted, or to sit tight and trust to its inconspicuous colouring. *Latifrons* adopts the first course, and it is so much on the alert that one has to come on a nest very suddenly to catch the bird unawares. It then departs abruptly, but does not go far—walking a little, stooping to pick up a morsel of food, looking anxious, walking again, picking up more food, and so forth. Nothing could be more undemonstrative. This form of behaviour is reserved for human beings; with regard to stock very different tactics are adopted. When a flock of sheep or goats passes near the nest, the bird stands firm and shrieks defiance at them, pecking at the legs of animals venturing too close. I regret to say that I missed the chance of seeing this for myself, but Somalis regard it as the normal procedure. As corroborative evidence I was shown a nest where I was told that the bird had behaved in this way. The site was a hard sandy patch on a route along which a flock of goats passed daily. In front

¹The concentration of large numbers of breeding pairs in the immediate vicinity of Garisa is a matter of interest. The two likeliest explanations I can suggest are that (a) the Somali herds of sheep and cattle create favourable conditions for the reproduction of insects upon which the bird feeds; (b) the most favoured nesting habitat is an open space with hard sandy soil, which (unless artificially cleared as at Garisa) is not often encountered, since it is on just such sandy patches that the bush usually grows thickest. Speculations of this nature are, however, entirely unprofitable unless supported by the evidence of a detailed ecological survey.

of the nest the whole surface was mottled by their tracks, but about a yard away these diverged and passed at a distance of about two feet on either side, re-joining immediately afterwards. In this instance the bird later deserted, though curiously enough the egg remained unbroken until I removed it a week later. I saw one nest that had been trodden on, showing either that the defence had not been effective, or that the parents were absent when the animals passed.

A Somali, who used to find nests for me, would drive a flock of goats past the likely places in the hope that the parents might betray the whereabouts of their eggs. Usually they did so. When searching for nests myself, I found a useful method was to dash at top speed on a bicycle to the place where I suspected that there was a nest; this gave the bird no time to retire unobtrusively, and the act of rising off the eggs could clearly be seen. Another method was by tracking. One day I was walking in the bush, and saw a bird running away as if it had a nest, but I had no idea exactly where this might be. I went to the place where I had seen the bird, and noticed that its tracks showed clearly in the sand. So I traced them backwards, and, after following them for a few yards, suddenly came on the eggs. Of course the orthodox method of watching the birds return to their nest was not neglected; it was most effective at mid-day when the parents were particularly anxious not to leave their eggs uncovered.*

Aggressive behaviour when stock approach the nest is not confined to this species. According to Mr. W. Krienke, it is a characteristic of both the Crowned Lapwing (*Stephanibyx coronatus*) and the South African Wattled Plover (*Afribyx senegallus lateralis*). He writes: "I have found that if a flock of sheep is handy and turned to graze over the ground where nests are suspected, the eggs are easily located, as the birds sit close till the animals are almost on them, when they will stand up with outspread wings, flapping excitedly in an endeavour to drive off the sheep." (Quoted in Priest, page 87.) In Kenya van Someren found that a dog was useful for discovering the nests of the Three-banded Plover (*Charadrius t. tricolor*) as the birds would rush at it and try to drive it away. (*Journal* for April 1933, page 189.)

Methods of brooding vary. If it is cool, *Latifrons* broods in the usual way, but in the heat of the day it squats on the long tarsus, hardly touching the eggs, and shields them from the fierce rays of the sun. At such times the feathers of the back are fluffed out and the wings slightly extended, so that the bird looks twice its normal size. It is usually seen to be gasping in the heat. I was able to observe this characteristic very closely when watching the bird at Saka. The disengaged parent often finds shelter a little distance away. I believe that both birds brood.

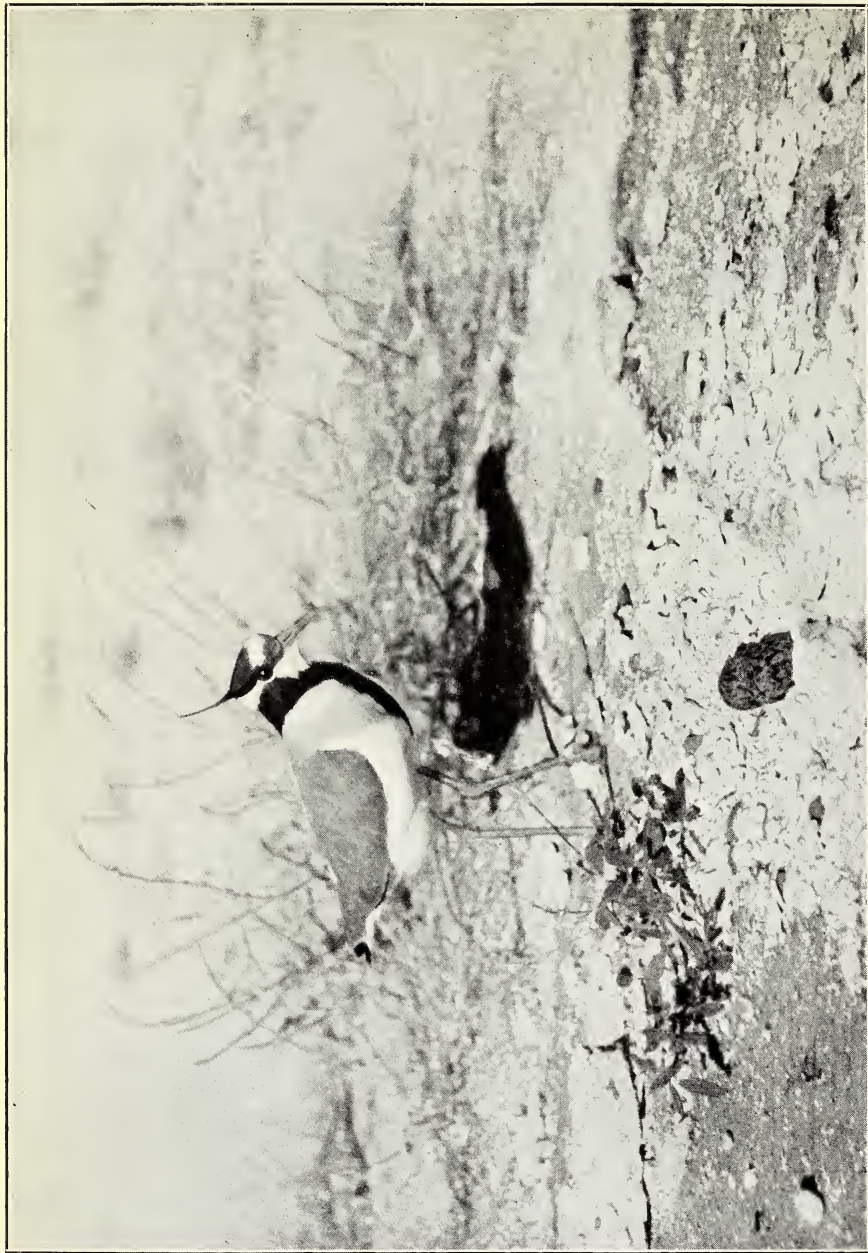
* I found that natives of the Malakote tribe were particularly expert at this method.

I found a nest of the Spur-winged Plover (*Hoplopterus spinosus*) in arid country not far from Garisa on March 6th, 1936—the hottest time of the year—and the birds behaved in much the same way. They were so confiding that I was able to watch them for several hours from a distance of thirty yards. The brooding bird fluffed out its feathers in the sunshine while its mate sheltered beneath a bush near by. The female sat on an empty nest for two hours, then the male took a turn for a few moments, with the female standing beside him. Soon she intimated that she wanted to return; accordingly the male got up, but before leaving the nest removed a piece of earth from the lining. The female then began brooding again, and an hour later I found an egg. This was three-quarters buried in the lining of the nest, presumably in the hole that the male had made.

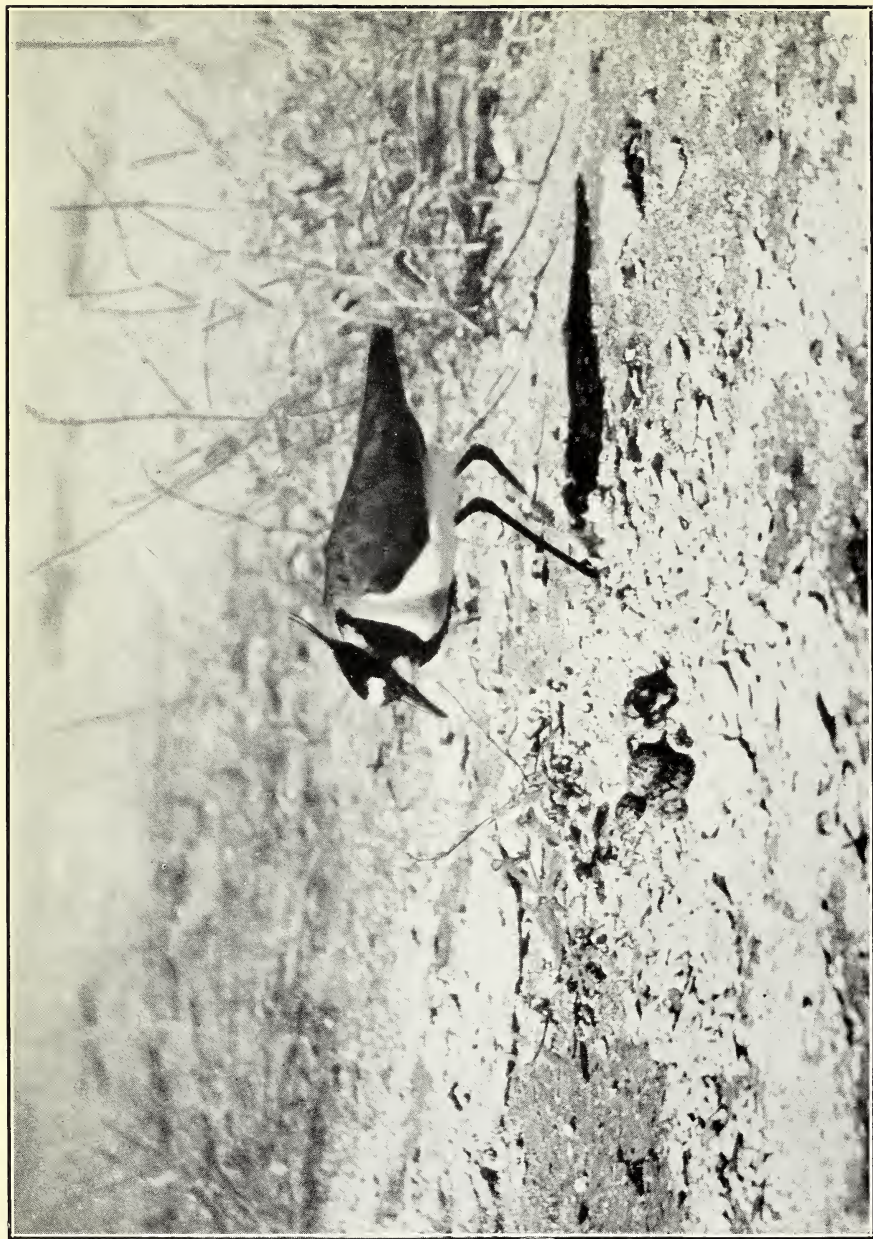
Mr. and Mrs. R. E. Moreau have recently published some interesting notes on the Masai Two-banded Courser (*Rhinoptilus africanus gracilis*) at Mkomasi in Tanganyika (*Ibis* for January 1937, page 161). The brooding habits of this species seem to correspond very closely with those already described for *Latifrons* and *Hoplopterus*. A nest with one egg was found on November 19th 1934, on a bare patch of ground. "The birds shaded their egg, practically without intermission, for at least ten of the daylight hours, sitting on their tarsi, and bending over the egg so that their breast feathers did not touch it. . . . the 'sitting' bird crouched, with bill open, facing the breeze, and with feathers ruffled so as to allow free passage of air through them. . . . the off-duty bird always sought the shade of a nearby *Suaeda* bush after sunset one of them brooded in the ordinary way." One is led to wonder whether this is the usual habit of the *Charadriidae* when brooding under conditions of great heat. Whether it facilitates the hatching of the egg seems to me uncertain; perhaps the main result is increased comfort for the bird. On Garisa landing ground I had opportunities of observing Sandgrouse (*Pteroclididae*) nesting in the open under exactly similar conditions to *Latifrons*, and at the same time of year. The birds always seemed to brood their eggs very closely and never ruffled their feathers like the plovers did. Yet the young appeared to hatch just as successfully.

DESCRIPTION OF THE NEST AND EGGS.

Nests may be of two kinds, open and hidden. By "open" I mean the usual wader type; by "hidden" those in which the eggs are buried in the lining so that only the tops show. This makes them remarkably hard to see. The following is a description of a typical hidden nest. The nest is placed right out in the open, on a hard sandy patch where there is a scanty covering of small creeping plants, dead twigs, black debris of leaves, thorns, etc. The cup is a slight scrape in the sand about 6 inches in diameter, lined with tiny pebbles, pieces of earth, twigs, dung, and even with some prickly six-pointed grass-



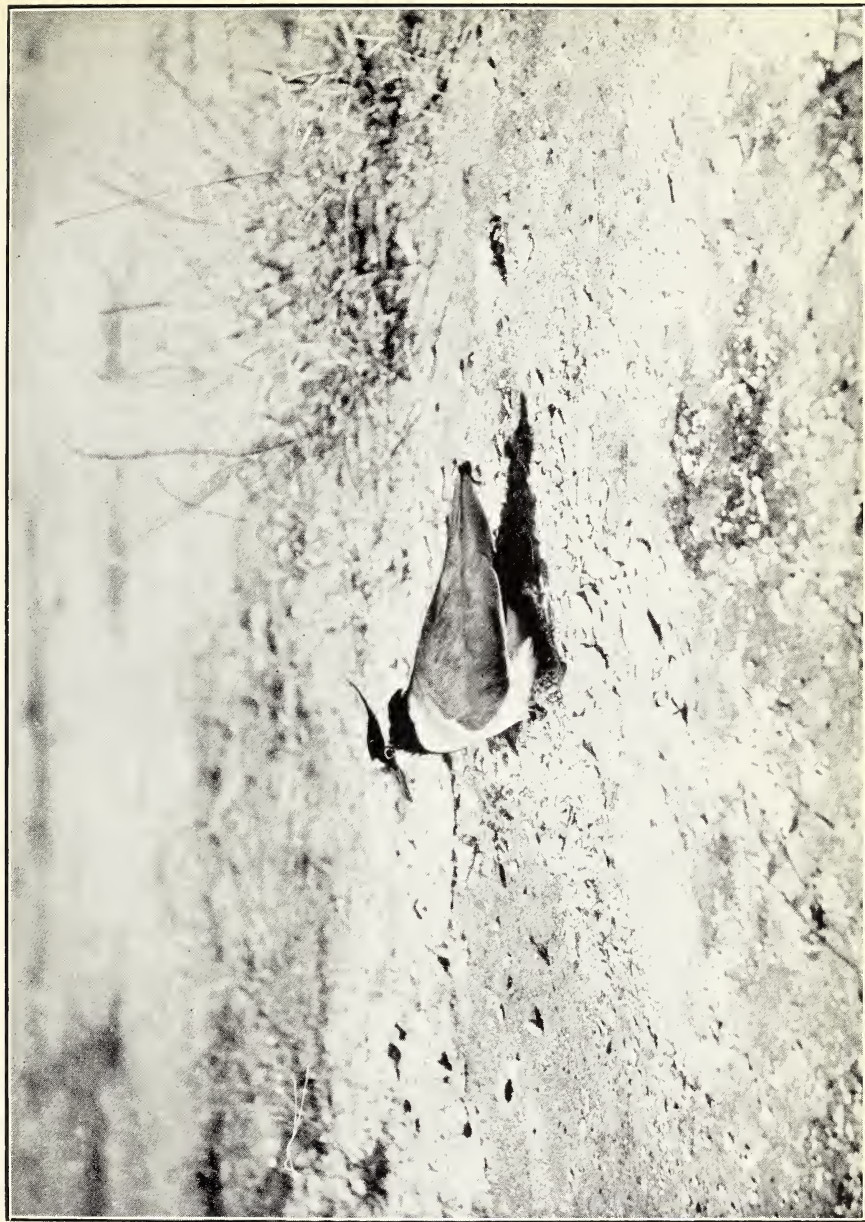
Crested Wattled Plover (*Sarciphorus t. latifrons*) at nest, Garisa landing ground, May 12th, 1936. The nest is a scrape lined with fragments of whitewash. This form of lining is abnormal.



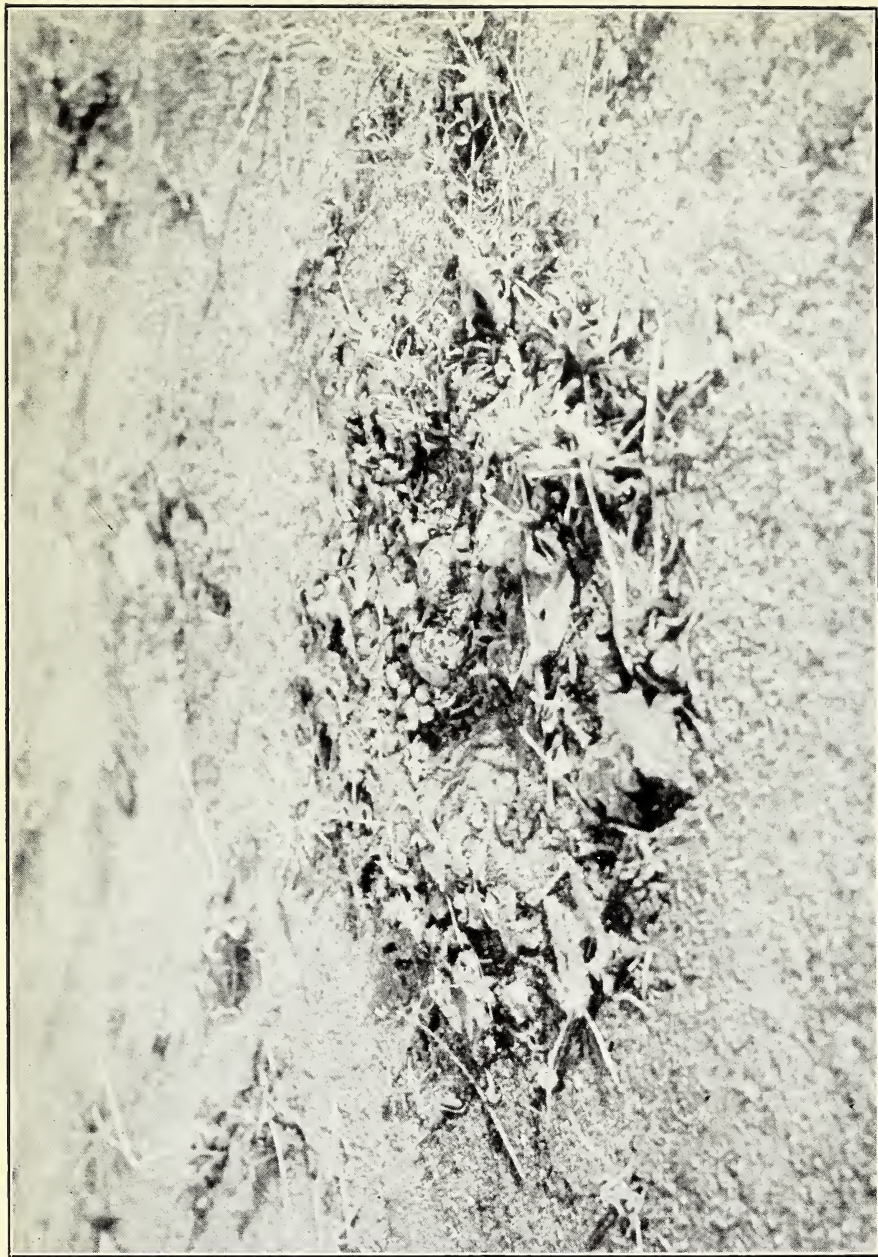
Same day and place; the bird returns to the nest.



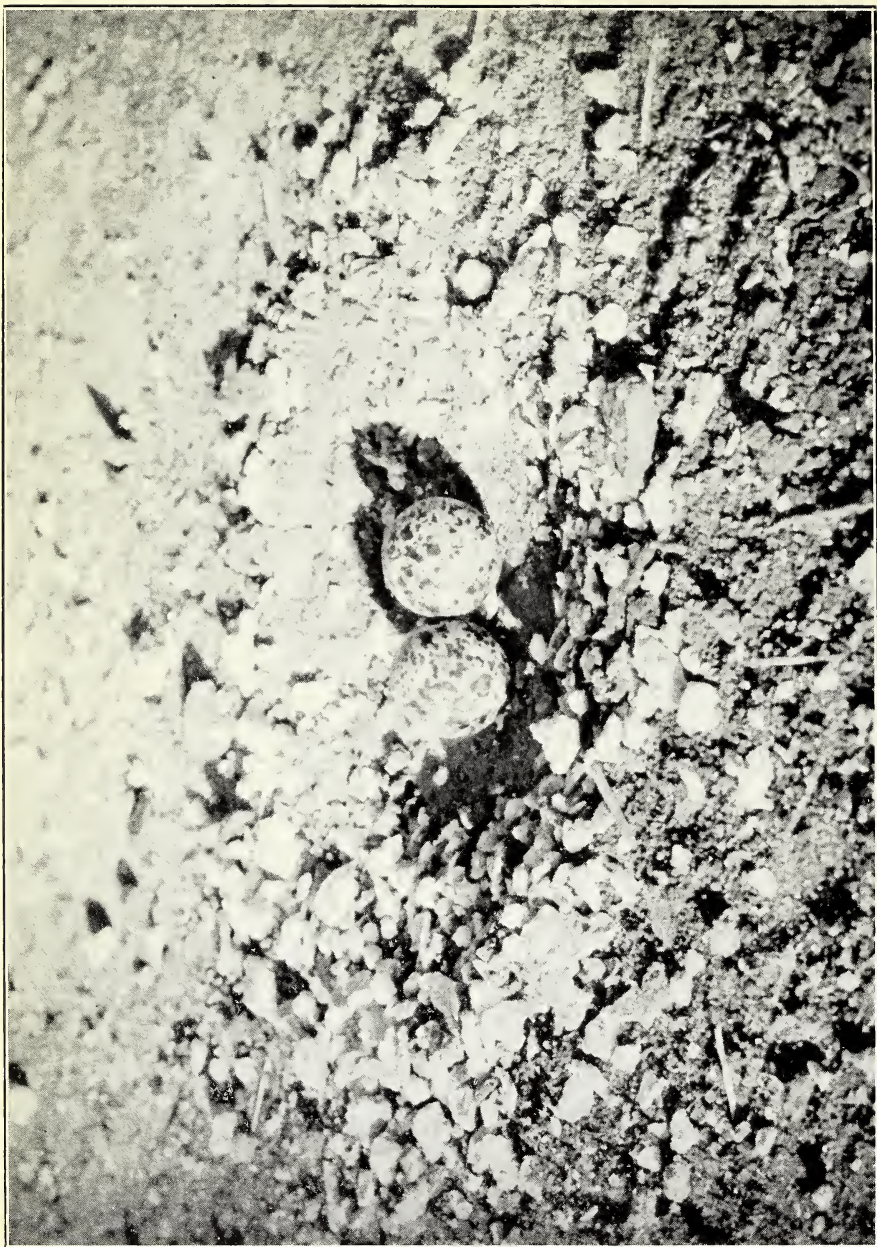
Examines the egg and the newly-hatched chick.



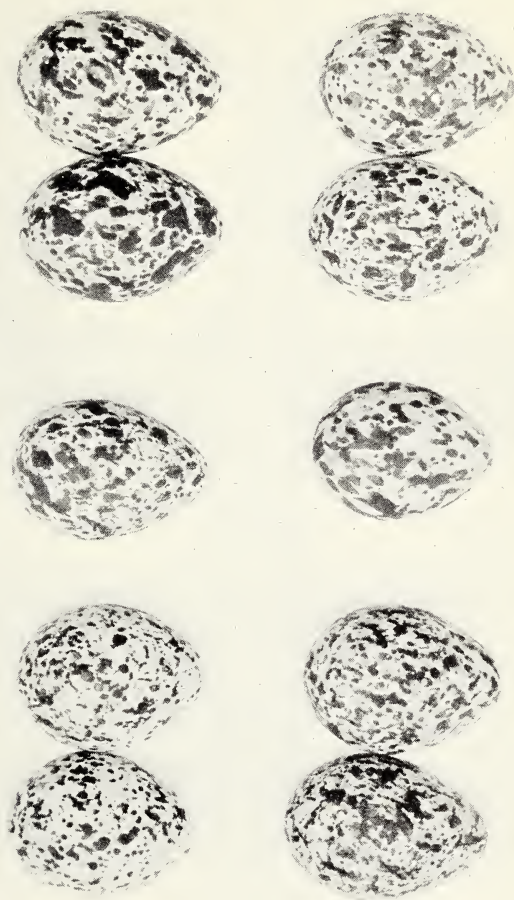
Settles down to brood keeping a watchful eye on the camera. The chick peeps out from beneath her body.



A typical hidden nest, landing ground, May 13th.



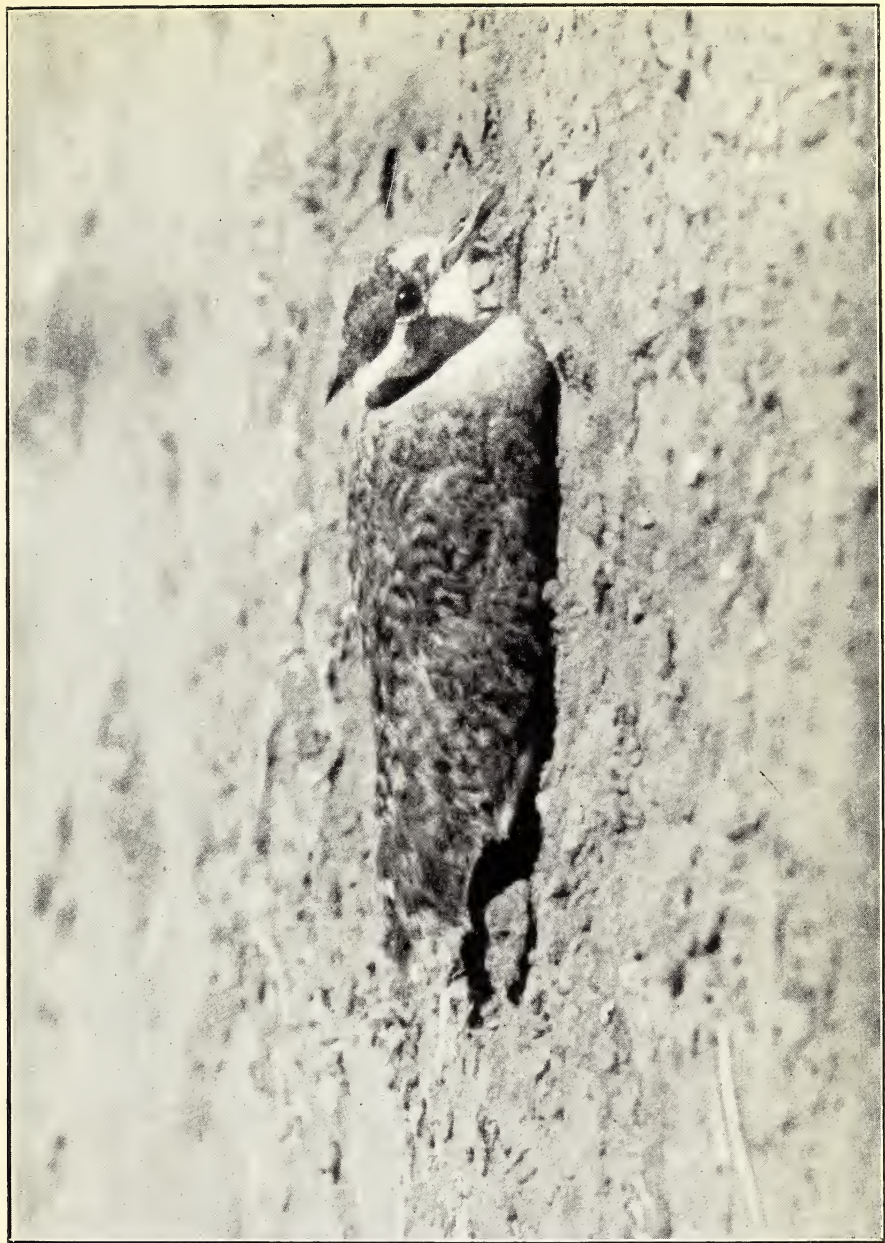
A typical open nest, same place, June 25th.



Six clutches of eggs showing variations in size, shape and colouring.



Newly-hatched chick in open nest near Garisa guard room, May 6th.



Fully fledged young, near Garisa station, July 1st.

seeds. The eggs are two in number, lying side by side, half-buried in the lining, their brown-and-buff colouration blending perfectly with their surroundings (Plate 5). An open nest is very similar, usually about $6\frac{1}{2}$ inches across, sometimes without a lining, but often lined with small pebbles or stones. No attempt is made to bury the eggs (Plate 6). Some open nests are very easy to find; quite the most conspicuous I can recall was that at which I photographed the bird (Plate 1). This was on the white-washed centre-mark of the landing ground, which at that time had been partly demolished by the rains. The nest was on a broken patch, and the eggs were enthroned upon a collection of some hundreds of small pieces of whitewash. Of twenty nests found, eleven were open and seven hidden, and two began by being hidden, then were altered to the open type. Both of the latter before being converted were seen to contain prickly grass seeds in the lining, which suggests that there was a practical reason for the change. Apart from these the tendency was to adhere to one or other type during the whole period of incubation. In two instances, however, I took the egg from a hidden nest, and subsequently the bird re-laid but changed to the open variety.* I found it impossible to say which type of nest was the more likely to be used in a given locality; the selection seemed to be indiscriminate, and to rest with the preferences of each individual bird. There was nothing to suggest the operation of a logical principle, such as that hidden nests should be constructed in the more frequented places (e.g. eight nests were found at the station, four open and four hidden).

Quite a number of the African waders bury their eggs, though their methods vary. Kittlitz's Sand-Plover (*Charadrius p. pecuarius*) habitually scratches sand or pebbles or caked mud over its eggs before leaving the nest. This has been noted by Priest in South Rhodesia (page 79), by Edelsten in the Orange Free State (quoted by Priest), by Belcher in Nyasaland (page 76), and by van Someren in Kenya (*Journal* for April 1933, page 187). In this species the habit therefore seems to be usual not only in the tropical but also in the comparatively temperate parts of its range. Mr. J. H. Vaughan (*Ibis* for 1930, page 2) gives a description of the nest of the Madagascar White-fronted Sand-Plover (*Charadrius marginatus tenellus*). He says that the eggs are laid in a depression in the sand, and at first are unconcealed. Gradually, however, sand is heaped round them making them all but invisible. In an accompanying photograph only the tops of the eggs can be seen. The Egyptian Plover (*Pluvianus aegyptius*) appears to be more thorough in this respect than any of the other species, as it buries its eggs completely and keeps them covered with sand even while incubating (Bannerman, page 205-6). From published

* In both cases the bird laid a single egg of distinctive shape and colouring, and the second clutch was found in the same place as the first.

accounts the Spur-winged Plover (*Hoplopterus spinosus*) does not normally possess this habit, though as already mentioned I have found a nest in which the single egg was buried. To summarise, as far as I can ascertain only five species have been observed to conceal their eggs in this way, all of them tropical nesters. In at least two of these (*Latifrons* and *Hoplopterus*) the habit is irregular; apparently the rest of the African waders can dispense with it without disadvantage. Thus the practice would seem to be of questionable utility.

The eggs have the typical wader colouring, but are less pyriform than many. In size they are about the same as a Kentish Plover's (*Charadrius a. alexandrinus*). Both in size, shape, and colouring they vary considerably; the six clutches shown in Plate 7 illustrate some of the varieties. Two eggs usually are laid, sometimes one; of fourteen clutches collected, nine are of two eggs, and five of one (and out of these latter two were almost certainly re-layings). The average size of twenty-three eggs is 34 x 25 millimetres; largest 37 x 25 (top right in the plate); smallest 32 x 24 (bottom centre). Even in the same clutch the size may vary, e.g. 37 x 25 and 35 x 25 (bottom left). The pair shown in the bottom right-hand corner are typical for size, shape, and colouring, although the stumpy type (bottom centre) is also common. Markings vary so much that it is often possible to tell a hen by the eggs she lays. The usual background is light stone-colour to warm buff; sometimes greeny-brown, sometimes pale yellowish buff. In a typical clutch (bottom right) there are irregular spots and patches of dark umber superimposed over chestnut, and numerous small light grey markings, all scattered freely over the stony-buff background. In one variety (top right) the umber patches are greatly increased in size, producing beautiful mottling; in another (bottom centre) the comparatively scarce markings make a bold pattern longitudinally with the egg; and in yet another (top left) the eggs are spotted after the manner of a Ringed Plover's (*Charadrius h. hiaticula*). I have one egg (not shown in the plate) which is scrawled rather than spotted. It is quite usual for the members of a clutch to be marked differently (bottom left). As regards incubation, in one instance only I found that the members of a clutch were unequally incubated; here one egg was slightly set and the other fresh. Mr. D. McInnes gives a similar instance for a Spur-winged Plover's nest with four eggs, but here the variation was much greater (*Journal* for October 1932, page 129).

All the clutches were taken in the immediate vicinity of Garisa, and by me personally. In each case I satisfied myself that the identification was correct; in two instances I collected the brooding birds, which appeared to be typical specimens. No other plover was breeding at the same time in the area from which the eggs were taken. The skins collected, together with a representative series of clutches, have been divided between the Coryndon and the British Museum.

MORTALITY FACTORS.

Mortality factors during the breeding period can be divided into two classes, animate and inanimate. On this subject the evidence I possess is distressingly inadequate; the notes that follow are therefore opinions rather than conclusions.

A. *Animate.*

(1) *Man.* The local Somali tribes do not appear to persecute the bird or to take its eggs. I think it is one of the numerous creatures that they refuse to eat.* On the other hand the river tribes (Malakote, Korokoro) catch a number of birds in snares. A small circle of sticks is erected round the eggs, with one entrance only, where the snare is concealed, and usually a capture is quickly effected.† As, however, the habitat of *Latifrons* is the "barra" or dry country that belongs to the Somalis rather than to the river tribes, I do not think that the breeding of the birds is intentionally affected by man to any great extent.

(2) *Other than Man.*—Of these I know practically nothing, though I suspect that they are by far the more important. A great many nests at the landing ground came to grief, through what agency I am uncertain. Possibly the ground squirrel or the small mongoose called in Swahili "Kitete" may have been responsible, or it may have been snakes. At the time that the plovers had eggs there was a hatching of caterpillars which attracted numbers of baboons and Marabou Storks (*Leptoptilos crumeniferus*), and in at least one instance I believe that a Marabou was responsible. This, however, I think was exceptional. The very real danger from stock has already been fully discussed. The Somalis told me that the birds use the same methods to drive off wild game.

B. *Inanimate.*

(1) *Rain and Floods.*—Practically all the nests that I saw were on hard sand and in situations unlikely to become waterlogged or flooded.

(2) *Sun.*—Nests are almost invariably constructed in the open, away from shelter, and the heat of the sun must be tremendous. A peculiar attitude assumed by the bird while brooding has already been described. Where nests are near human habitations, the birds are frequently obliged to leave their eggs for considerable periods. I remember three nests that were particularly liable to disturbance: one near the guard room, one at Saka, and one where the bird itself was photographed. Yet all hatched successfully; a striking example of the heat-resisting capabilities of a plover's egg. Such capabilities, however, must have their limits, and the birds (as already stated) are most unwilling to leave their eggs uncovered during the heat of the day. A

* The Somali name is Wir-wira—a good phonetic rendering of the call.

† The Malakote name is Darsalaga.

deserted egg I blew, which had been lying unprotected for a week, was practically soft-boiled! I fail to see what advantage the hidden type of nest may have as regards protection from the sun. The eggs are only half-buried, and the rays can strike down on them without hindrance if the brooding bird is absent. The three nests mentioned above were all open. §

DESCRIPTION OF THE YOUNG.

The newly-hatched chick in down (Plate 8) has the typical colouration of a young wader. The crown of the head is covered with black and golden spots, with a short black stripe on the crest, and a similar stripe extending from ear-covert to ear-covert around the nape of the neck. Round the neck itself there is a broad white collar which divides the spotted crown from the similarly spotted back and wings. The throat, cheeks and under-parts are white; bill dark grey; legs and feet grey; eye dark. When lying flat the bird is very hard to see, as the upper parts—which in colour strongly resemble the egg—blend perfectly with their surroundings, but when the chick is running or standing the white collar becomes most conspicuous. Mr. A. L. Butler (quoted in Bannerman) states that the young of the Egyptian Plover possess exactly the same characteristic; he suggests that the white patch enables a mother to keep her nimble little chicks in sight.

In the fledged young (Plate 9) the back is spotted with two shades of brown, as is the crown, and there is a slight crest. A black band extends from cheek to cheek round the back of the neck, terminating under the eye, where it widens to meet the lower eyelid, thus dividing the white nape from the white throat. The under-parts are white, except for some light brown on the breast; the central black band which is so conspicuous in the adult has not yet developed. I regret I cannot give the colours of the soft parts, as I stupidly forget to write them down when photographing the birds.

BEHAVIOUR OF BIRDS WITH YOUNG.

I have already said that birds with eggs are most undemonstrative when a human being approaches. But as soon as the young are hatched their behaviour changes, and the intruder is greeted with anxious cries which increase in intensity as he comes nearer. On May 7th I watched the pair near the guard-room; their chick (Plate 8), which I had photographed the day before, was no doubt hiding somewhere near. The parents kept on calling, and allowed me to approach within ten yards of them. They walked round with the head held low and

§ Note: The breeding habits of this plover seem to differ surprisingly little from those of a European wader such as the Lapwing (*Vanellus vanellus*). The differences that I noted were four in number: (1) a smaller clutch, (2) a modified method of brooding, (3) burying the eggs, (4) driving off stock approaching the nest.

the crest flat on the back; every few steps they would stop, pick up something out of the sand, and eat it. But in addition to this they would crouch down, with the bill almost touching the ground, in what I took to be the mating position. This assumption proved to be correct, because while one of the pair was lying thus, the other leaped suddenly on to its back. The act only lasted for an instant, then both birds resumed their anxious cries and their prowling. But it struck me as a very interesting piece of behaviour, because although mating is probably the most powerful impulse in a bird's life, there appears to be no logical connection between this and the main feelings of the birds at the moment, which were anger at my presence and anxiety for the sake of the young. Such anger might have found a natural outlet if the birds attacked me, but they did no such thing. Thus their emotion, which had to find expression somehow or other, was diverted into unnatural channels. To borrow a phrase from Mr. Eliot Howard ("The Nature of a Bird's World," page 19) if anger was their master reaction, pretending to mate was a false reaction attendant upon the anger.

I have not commented on the pretended or actual picking-up of food when a bird is disturbed at the nest, although this is probably another "false reaction." It may, however, have practical value in convincing the inexperienced intruder that a bird which is so obviously feeding cannot possibly have eggs near by! In reality the peculiar attitude assumed by the bird while prowling round and picking up food is a patent admission of the vicinity of the nest. The habit is, I think, common to many plovers, both African and European. Krienke discussing the Crowned Lapwing (*Stephanibyx coronatus*) and the South African Wattled Plover (*Afribyx senegallus lateralis*) says that as soon as danger is apprehended the hen slips quietly off the nest in a crouching attitude and immediately makes a pretence of being engaged in feeding (quoted by Priest, page 87). Mr. T. A. Coward says of the Lapwing (*Vanellus vanellus*) in England: ". . . the sitting bird leaves the nest silently, running for a few yards, and artlessly pretending to feed. . . . I have lain beside the chick and watched the old bird run towards me, stopping every few yards to pick up imaginary food." ("Birds of the British Isles," Vol. II, page 200.) No doubt such instances could be multiplied indefinitely. The observers quoted both say that there was only a "pretence" at feeding. While watching the Crested Wattled Plovers with young, however, I definitely saw a bird pick up something and eat it; this occurred several times and I am sure there was no pretence.

At Garisa I used to encourage a young Somali herd-boy to look for nests for me, and found him both reliable and observant. On May 11th he told me that he had seen a bird fly off with one of her young held between her legs. I note this in case the record may be confirmed later.

Owing to pressure of work during the first half of May I had to limit photography of the birds at the nest to one morning only. The hide was erected from sunrise to sunset for several days before I photographed—an unsatisfactory process, but I dared not leave it up at night for fear that it might be stolen. At 7-30 a.m. on May 12th I entered the hide, focussed my camera on the eggs five feet away, and told my assistants to depart. The birds, which had been watching from a distance, soon returned. They walked round the hide and tried to peer in, uttering loud angry cries that sounded to me like “Yah! Yah! I see you!”—from which I gathered that the measures taken to deceive them had not been at all successful. However, the call of the eggs was imperative; soon the bird I believed to be the female (Plate 1) was standing only a foot away from the nest, then she settled down to brood. A little later the sun came out, and I saw that the shadow of the hide cut directly across the nest, so that the bird, when brooding, was half in sunlight and half in shade. This was intolerable, and there was nothing for it but to summon my helpers and to move the hide a little to one side. While doing this I saw that one of the eggs had hatched. I feared that the change of position might upset the bird even more, but I misjudged her. Nothing could lessen her suspicions of the hide, but the time was too critical to allow her to stay away. So back she came, walking quickly in a crouching position (Plate 2), flopped down suddenly, wagged her tail, and began to brood. I noticed that she was squatting on the long tarsus in the manner previously described. Even while brooding she continually uttered warning cries. But in time she calmed down a little, and the chick peeped out from beneath her body (Plate 4), and I was able to take as many photographs as I liked. When I had finished, I removed the camera and looked out of the large hole in the front of the hide where the lens had been, expecting that she would fly off at once. She did retire for a few yards, but then to my surprise came back and proceeded to brood as before. After a few moments I emerged, dismantled the hide as quickly as possible, and left the birds in peace.

SUMMARY.

To summarise: *Sarciophorus tectus latifrons* was found breeding in 1936 at Garisa on the Tana River, in the Northern Frontier District of Kenya. *Sarciophorus tectus tectus* has been discovered nesting in West Africa and in the Sudan, but I believe this is the first time that the eggs of *Latifrons* have been described. The bird nests in numbers along the Tana between Saka and Bura, and is found in the desert to the east, but north and west of Saka it does not seem to occur. Its haunts, both for feeding and nesting, are hot, low-lying, sandy, scrub-covered plains, only three to five hundred feet above sea-level. It does not frequent the margins of pools. The breeding season was in May (after the April rains). No observations were made on courtship, and

the incubation and nestling periods were not discovered. Many nests were found near the houses and the Somali "manyattas" at Garisa, though the most favoured area was the landing ground, which is an abnormally large open space for a country chiefly scrub-covered. The brooding bird will slink off quietly if a human being appears, but on the approach of sheep or goats it will stay beside the eggs and attempt to drive the animals off. In the heat of the sun it fluffs out its feathers and squats on the long tarsus, shielding the eggs rather than brooding them. Sometimes the eggs are deposited in a scrape in the normal manner; sometimes they are to be found half-buried in the lining. It is impossible to say which method will be employed. The clutch is usually two, sometimes one. The egg is sub-pyriform, and has the usual wader markings. The average size of twenty-three eggs is 34 x 25 mm. Eggs vary considerably both in size and colour. Two skins of brooding birds were obtained to ensure correct identification. Little was discovered about mortality factors in the breeding season, but a summary is given of the evidence obtained. The chick and the fledged young are described. The peculiar behaviour of a pair of birds with young is discussed, as is the habit of "food-pecking." In conclusion a short account is given of the photography of the birds from a hide. Photographs are included illustrating the adult bird at the nest, the two types of nest used, the chick and the fledged young, and the variations in the markings of eggs.

EAST AFRICA AND UGANDA NATURAL HISTORY SOCIETY.

TWENTY-SIXTH ANNUAL REPORT. YEAR ENDING DECEMBER 31ST, 1936.

In submitting our Report on the progress of the Society and its activities for the year 1936, we propose to follow the precedent of recent years in maintaining a distinction between public activities, and those conducted solely for the benefit of members.

While doing so, we fully realise that the functions of the Society within the Coryndon Memorial building are closely related to the carrying out, so far as we are able to, the original intentions of the Memorial to the late Sir Robert Coryndon. This distinction is rendered the more desirable and more difficult in view of the fact that the opinion has been expressed, that by virtue of public grants having been made, some of the material donated during the past five years, or prepared for exhibition, should in reality be the property of the public.

Your Society was invited by Government and the Coryndon Memorial Executive to initiate the functions which form an integral, and indeed, the major part of the memorial.

The Society thus functions in a dual capacity, and this Report must of necessity, not only embrace a record of work, for the information of members of the Society, but must also include an account of our stewardship in respect of the Memorial to Sir Robert Coryndon, for the information of the public, who subscribed to this memorial. The position is an anomalous one, in that there would appear to be no other organisation responsible to the public, in spite of the fact that public monies, both Government and Municipal, are voted toward the carrying out of these functions.

We will deal first of all with that part of the report which is of particular interest to members of the Society.

MEMBERSHIP.

We are glad to state that there has been no falling off in membership, except in one particular section which will be referred to later, but this has been more than compensated for by admissions of new members, ordinary and institutional. Members doubtless recollect that at the last Annual Meeting, a new class of membership was approved, viz. Institutional; this has been taken advantage of by overseas Museums, Research Centres, local libraries, and schools. Mr. H. L. Sikes, our past President, was elected to Honorary Life Membership in recognition of his services to the Society during a period of twenty years; eighteen new members were elected as a set off against sixteen names removed from the register under Rule 8c of the Constitution. We regret that included in this latter were several Asian citizens who

had previously taken advantage of the "open" membership of the Society. We trust that these resignations will be temporary, and that Asian citizens and other nationalities will support the Society in the future, the more so in view of the fact that amongst visitors to the Museum are included a very large number of Indian scholars, and pupils of non-European schools, who are admitted free.

The income derived from subscriptions was more than anticipated, and reached one-third of our total income exclusive of admission fees to the Museum.

PUBLICATIONS.

Members are aware that for the last five years your Executive has held the view that the publication of the Journal is an essential link between the Society headquarters and its widely distributed membership, both local and overseas, and Scientific Institutions all over the world. To this end therefore we have voted the bulk of the funds derived from members' subscriptions. The allocation of revenue from this source toward the cost of running expenses and development of the public museum, though advocated in some quarters, is to be deprecated.

Two double numbers of the Journal were issued, equal to four quarterly numbers, at a cost of over £300. The standard of subject matter has been maintained and there has been no lack of original contributions; on the contrary, the number of MSS. submitted is more than we are able to accept for publication, due entirely to lack of funds. This demand for space has led your committee to over-expend the publication vote during the past three years, and it is under this heading that a deficit appears on our Revenue and Expenditure Accounts.

Some criticism has been made recently by contributing bodies toward the Coryndon Memorial, regarding the smallness of the income derived from the sale of the Journal. It must be clearly understood that four-fifths of the total number of Journals issued are distributed free to members and to overseas Museums and Institutions in return for subscriptions or Journals received in exchange. It is by this means that we have built up a reputation as a scientific society, recognised throughout the world, and it is the link which holds membership together at its present high level. The holding up of MSS. is to be regretted from many points of view, not the least being that delayed publication will tend to curtail the ready submission of suitable papers, and these contributions, of particular interest to Kenya, will go elsewhere.

LECTURES.

Public lectures were suspended during the year. Dr. Geilinger's lecture on the Ruwenzori Mountains, delivered at our last Annual Meet-

ing, drew a large attendance. Members of the staff have continued to give lectures to certain schools, with a view to building up a reserve of naturalists on whose shoulders the maintenance of the Society so much depends.

Several private demonstrations were given in the Laboratories to interested individuals and parties of school children. It is appropriate to emphasise here that without adequate staff and facilities the number of lectures and talks must remain small.

STUDY COLLECTIONS.

We are glad to report that accessions to the study material have been very considerable, and indeed, in certain divisions have surpassed those of previous years. More particularly is this the case in the Entomological Division. This will have a direct reflex in the event of funds being available for cabinets for systematic collections; those sections which are most supported should have prior claim to consideration when funds are forthcoming. Outstanding contributions have been made by Mr. C. S. MacArthur, Mr. Allen Turner, and Mr. Gedye; whilst the biological series have been augmented by over 10,000 specimens as the result of intensive breeding work in Lepidoptera and Diptera carried out by the Curator. Mr. A. L. H. Townsend has made valuable contributions of bred series of Heterocera from the Nakuru district, filling in many blanks in the systematic series and adding three new species to science. Considerable bred and captured series have also been contributed by Mr. G. van Someren.

A duplicate series of insects and other material taken by the Cambridge University Expedition to Lake Rudolf was presented through the Keeper of Entomology, British Museum.

Messrs. Krauss and Bianchi of the Department of Agriculture, New York, were given assistance in their work on Trypetidae (fruit flies) and their parasites; material was exchanged and associated botanical material was identified in the Society's Herbarium. This work on fruit flies is now being continued by the Curator in collaboration with Mr. Allen Turner, and Mr. Munro of the Department of Agriculture, Pretoria. Several new species along with their parasites have been bred out, and it is hoped in due course to publish a report on this important line of entomological research. Mr. T. H. E. Jackson, of Kitale, during his recent home leave, revised the group of Nymphalids which will be dealt with in the forthcoming continuation paper on Lepidoptera of Kenya and Uganda. Mr. Jackson also rearranged the entire collections of Lycaenidae and Hesperidae in accordance with recent work on these groups. Some 300 specimens of Hesperidae were submitted to Brig.-General Evans of the British Museum for revision. This has resulted in the description of new species and alterations in the Check List he is preparing for the British Museum.

The entire group of the Genus *Bematistes* (*Planema*) has been submitted to Dr. le Doux of Berlin for critical examination and report.

Large batches of insects have been submitted to the Imperial Institute of Entomology, London, during the year. As hitherto, the Society has been the largest contributor of East African material to this Institution. Four thousand four hundred and thirty-five insects were submitted for determination comprising 3,316 Coleoptera, 263 Orthoptera, 357 Rhynchota, 311 Diptera, 185 Hymenoptera, and others of mixed groups. This material has not only enriched the National Collection at the British Museum, but has resulted in the description of dozens of new species. Mr. Gedye continued in charge of the Coleoptera, Orthoptera and Hemiptera. His work and assistance in this division has been invaluable and the insect collections are now the most comprehensive and best arranged of any in Eastern Africa. As heretofore, we have to acknowledge our indebtedness to Sir Guy Marshall of the Imperial Institute of Entomology for assistance in determining material and submitting certain groups to specialists for identification. A census made towards the beginning of the year gives a total of 100,000 named insects already incorporated in the systematic collections. There still remains about half this number to be worked out, identified, or submitted to the Imperial Institute of Entomology.

The bird collection was considerably augmented by material donated by Mr. G. H. E. Hopkins of Uganda; by valuable material from Mount Kenya presented by Col. Meinertzhagen and Capt. Pollen, and Mr. Raymond Hook.

The Mammal collections have been added to as opportunity offered. The most noteworthy acquisition was that of a skin of the "Tiger Cat" (*Profelis aurata cottoni*), a species not previously recorded east of the Congo Forest.

Owing to the untimely withdrawal of the Botanist, additions to this section have been irregular and considerably curtailed. Valuable material was donated by the Forestry Department, and some 200 specimens were contributed by the Museum staff. The systematic work in this section has come to a standstill, a regrettable position, in that not only has the Society's collection suffered, but we have ceased to be a "feeder" to the Herbarium at Kew.

In view of the number of persons interested in botany, it is not a little surprising that voluntary assistance in this section should not have been forthcoming.

The geological and mineral collections have been considerably augmented, while archaeological material has been added to by a long series of stone implements and pot fragments donated by Mr. H. S. Montague of Kiambu, and valuable collections presented by Archdeacon Owen.

The degree to which the general study collections have been made use of by members of the Society and the public, and students from overseas, has been gratifying. Laboratory accommodation has been placed at their disposal. The practical utility of these systematic collections may be gauged from the following records: The Herbarium has been made use of by members of the Agricultural Department of Kenya in connection with the host plants of cotton pests; by Messrs. Krauss and Bianchi and the Museum staff in the identification of material associated with the investigations in fruit flies. The entomological collections were consulted by members of the Agricultural Department in connection with pests of rhami fibre and information was supplied on the biology and methods of control of the insects concerned. The bird collection was made use of by Mr. Hopkins of the Agricultural Department of Uganda in determining the hosts of *Malophaga*; reference has also been made to it by Mr. Moreau of the Agricultural Research Institute at Amani; by Capt. Grant and members of the Ornithological section of the British Museum. The Mammal collection has proved its utility in determining species collected by the Tsetse Research Officer at the Coast in his investigations into possible reservoirs of Trypanosomes and food supply of tsetse flies; and it has also been consulted by members of the Kenya Game Department. Assistance was given to the Agricultural Department, Kenya, in the determination of rodent pests and methods of control were supplied.

In this way, then, the Society has endeavoured to carry out, in some small way, the objects and intentions of the Memorial to Sir Robert Coryndon.

LIBRARY.

Accessions by purchase and exchange have increased the utility of this important adjunct to systematic work. The maintenance of contact with other institutions has only been rendered possible by the valuable services of Mrs. Hansen, who undertook the duties of part-time Librarian and Secretary. The expansion and re-arrangement of the Library was facilitated by the addition of further steel shelving purchased with part of the Carnegie Corporation Grant. The true value of the Library can only be gauged by the facilities provided for ready reference, viz. a subject card index. This important part of Library organisation was suspended some three years ago on the withdrawal of a full-time librarian. It was an unavoidable but nevertheless retrograde step, beyond the control of your Committee. It is a matter which should be rectified as one of the first steps of re-organisation.

MUSEUM PROGRESS.

The public side of our activities, as represented by the public exhibition hall of the Coryndon Memorial, has continued to prove a

constant draw. The number of visitors has greatly increased, totalling 3,906 as compared to 2,200 in 1935. Of this number, only some 1,706 were admitted on payment; 2,200 were admitted free, of which 1,276 were students and school children, the balance being natives.

Increased publicity as the result of the erection of two large notice boards in conspicuous places in the town has contributed toward the increase in visitors, and it is not out of place here to record our thanks to the Municipal Council of Nairobi for permission to erect these sign boards. We also record our thanks to the management of the Kenya Bus Services for advertising the Museum on the service which passes the Institution. This concession was obtained through the kindness of Mr. Davidson of the Municipal Council, to whom our thanks are due.

Three special exhibits of birds were staged during the year, each exhibit being equipped with complete catalogues giving information regarding habitat, habits, and full distribution of the species shown. Several additions were made to the general Bird, Mammal, and Insect exhibits.

The outstanding addition to the "set pieces" was the installation of a "Lake Birds habitat group," rendered possible by the generous grant from the Carnegie Corporation of New York. This exhibit, unique in type, has proved a great attraction and amply justified expenditure in this direction.

Some comment has been made both locally and in the overseas press regarding the situation of the Coryndon Memorial Museum. Critics have either been unaware, or have lost sight of, what the actual memorial to Sir Robert Coryndon really is, and why a large area of land was set aside for this memorial. In actual fact the memorial is centrally situated in respect to the entire township of Nairobi. The Museum is only part of the very comprehensive memorial scheme.

FINANCE.

This, the keystone of our activities, has been far from satisfactory for some years, and acutely so during the period under review. The Carnegie Corporation grants, 1935-36, enabled the Society to maintain development not only in the public side but in the systematic work also. Had it not been for this timely assistance from foreign sources, the Society would have been considerably handicapped in its activities.

Grants in aid from Government and the Municipality were maintained on the same reduced rate as in 1934-35. On the other hand, income, other than grants, showed an increase; nevertheless, we carry forward a deficit on the year's working of roughly £100.

Members will recollect that at our last Annual Meeting it was unanimously resolved to request Government to appoint a public committee of enquiry into the conduct and management of the Coryndon Memorial, this, as an outcome of increasing difficulties, financial and otherwise, which faced us, culminating in public criticism of the

Society's functions. We regret to record that up to date no such enquiry has been held, but as a result of representations in various quarters, there is every prospect that a committee will be appointed during 1937. One outcome of these representations has been the increase of £100 on both public grants, both conditional on a full investigation of the position. The position is, however, far from satisfactory.

The Balance Sheet and Financial Statement, now before the meeting, show that the Society is in a very strong position so far as assets are concerned, nevertheless it is equally made clear that the Society, as a private body, is financially unable to carry the burden of the Memorial to Sir Robert Coryndon.

GENERAL ACTIVITIES.

Under this heading we propose to deal briefly with certain matters connected with the preservation of the fauna of Kenya, on which your Committee has expressed definite views. The most important item was the proposal to set aside certain areas as game sanctuaries. The general problem is one connected with Empire policy on game matters, and is outside our province at the moment; nevertheless, one particular proposal which has received the approval in general terms of both the Colonial Office and our local Government, relates to that area south of Nairobi, now known as "Lone Tree." In collaboration with the Game Department and the District Commissioner, a memorandum on the subject has been submitted to Government. Though Government has not, as yet, given final sanction, there is reason to believe that this unique natural zoo will be vested in a Board of Trustees, to be developed and maintained in perpetuity for the peoples of Kenya as well as citizens of Nairobi.

The matter of "Close seasons for Game Birds" has also received attention, and the policy of your Committee is to help forward applications from the various districts for the proclaiming of closed periods. Advice regarding proposed regulations governing the exportation of wild birds was also sought by the Game Department.

In submitting this report, which, as already indicated, is not only a record of progress of activities of the Society, but also an account to the public regarding the manner in which the Society, as the executive agents of the Coryndon Memorial Trustees, has fulfilled its obligations, we take the opportunity of thanking both Government and the Municipality for their continued financial help. We also record our thanks to the Carnegie Corporation of New York and the Empire Grants Committee of the Museums Association for timely assistance; and to all those who have assisted in the work of the Museum and Society, by voluntary services and the donation of specimens.

V. G. L. VAN SOMEREN,
Hon. Secretary.

BALANCE SHEET AS AT 31st DECEMBER, 1936.

| CAPITAL & LIABILITIES. | | ASSETS. | |
|-------------------------------|-----------|-------------------------------------|----------------|
| | Shs. Cts. | | Shs. Cts. |
| GENERAL FUNDS. | | CASH ON HAND. | |
| Surplus, as per A/c. attached | 70,417 25 | At Bank | 935 00 |
| CARNEGIE FUND. | | On Hand | 184 39 |
| Deficit, as per A/c. attached | 705 56 | | |
| | | SUNDRY DEBTORS. | 1,119 39 |
| SUBSCRIPTIONS PAID IN ADVANCE | 69,711 69 | Subscriptions | 430 00 |
| SUNDRY CREDITORS | 300 00 | Sundry | 485 30 |
| | 3,779 47 | | |
| | | GENERAL ASSETS (as per Schedule 1). | 915 30 |
| | | As per last Balance Sheet | 88,896 16 |
| | | Additions since | 8,794 33 |
| | | | |
| | | Less Total Depreciation | 97,690 49 |
| | | | 37,753 57 |
| | | JOURNALS OF THE SOCIETY | 59,936 92 |
| | | (as per Schedule 2) | 11,819 55 |
| | | | |
| | | | Shs. 73,791 16 |

We have prepared the above Balance Sheet from the Books and Papers of the East Africa and Natural History Society and from information supplied to us by the Curator, and certify same to be in accordance therewith.

Nairobi,
1st March, 1937.

For GILL & JOHNSON,
L. GILBERT.

GENERAL REVENUE FOR THE YEAR ENDING DECEMBER, 1936.

| EXPENDITURE. | | INCOME. | |
|-------------------------------|-----------------------|--------------------------------|-----------------------|
| 1936. Dec. 31. | Shs. Cts. | 1936. Dec. 31. | Shs. Cts. |
| Salaries and Wages ... | 12,566 48 | Government Grant ... | 6,000 00 |
| Light, Heating, and Water ... | 882 10 | Municipal Grant ... | 6,000 00 |
| Postages and Telephone ... | 735 21 | Subscriptions ... | 5,441 00 |
| Signboards ... | 295 00 | Visitors ... | 1,706 10 |
| Printing and Stationery ... | 241 25 | Miscellaneous ... | 181 27 |
| Insurance ... | 309 10 | Excess Expenditure over Income | 290 56 |
| Periodicals ... | 203 00 | | |
| Miscellaneous Expenses ... | 928 77 | | |
| Free Issues of Journal ... | 3,294 52 | | |
| Bad Debts ... | 163 50 | | |
| | <u>Shs. 19,618 93</u> | | <u>Shs. 19,618 93</u> |

CARNEGIE GRANT.

| 1936. Dec. 31. | Shs. Cts. | 1936. Dec. 31. | Shs. Cts. |
|----------------------------------|----------------------|--|----------------------|
| Furniture, etc., Habitat Room .. | 6,594 33 | Grant ... | 6,000 00 |
| Microscope ... | 200 00 | Miscellaneous ... | 394 36 |
| | | Excess Expenditure transferred to Capital Fund Account ... | 399 97 |
| | <u>Shs. 6,794 33</u> | | <u>Shs. 6,794 33</u> |

CAPITAL FUND ACCOUNT.

| DEFICIT. | | SURPLUS. | |
|-------------------------------|-----------|-------------------------------------|----------------|
| 1936. | Shs. Cts. | 1936. | Shs. Cts. |
| Jan. 1. | | Jan. 1. | |
| Carnegie Fund : | | General Funds : | |
| As per last Balance Sheet | 151 64 | As per last Balance Sheet ... | 65,957 18 |
| Adjustment of 1935 items | 153 95 | Adjustments on last year's accounts | 165 45 |
| Excess expenditure, 1936 | 399 97 | | |
| Balance, as per Balance Sheet | 705 56 | Less Depreciations of Assets | 66,122 63 |
| | 69,711 69 | for the year ... | 2,209 15 |
| | | Less Excess Expendi- | |
| | | ture for the year | 290 56 |
| | | | 2,499 71 |
| | | | 63,622 92 |
| | | Carnegie Grant expended on | |
| | | Fixed Assets ... | 6,794 33 |
| | | | Shs. 70,417 25 |

Schedule 1.

SCHEDULE OF ASSETS AND DEPRECIATIONS.

| | As per last Balance Sheet. | Additions during year. | Depreciation 1/1/36. | Depreciation for year 1936. | Nett value. |
|-------------------------------|-------------------------------|---------------------------|--------------------------------------|-----------------------------------|----------------|
| | Shs. Cts. | Shs. Cts. | Shs. Cts. | Shs. Cts. | Shs. Cts. |
| Aviary ... | ... | — | 1,200 00 | 144 00 | 1,656 00 |
| Botanical Cabinets ... | ... | — | 1,074 00 | 56 60 | 509 40 |
| Cabinets—General ... | ... | — | 16,015 00 | 1,189 50 | 10,705 50 |
| Metal Show Cases ... | ... | — | 9,094 40 | 291 32 | 14,275 00 |
| Wooden Show Cases ... | ... | — | 3,125 12 | 214 14 | 1,927 28 |
| Furniture ... | ... | 6,594 33 | 1,854 10 | 185 41 | 8,263 02 |
| Metal Fittings ... | ... | — | 80 00 | 14 40 | 705 60 |
| Electric Heaters ... | ... | — | 616 00 | 26 40 | 237 60 |
| Instruments and Apparatus ... | ... | 200 00 | 642 20 | 47 25 | 1,097 75 |
| Miscellaneous Assets ... | ... | — | 353 40 | 40 13 | 361 22 |
| Books and Library Account ... | ... | 2,000 00 | 1,490 20 | — | 20,198 55 |
| | Shs. 88,896 16 | 8,794 33 | 35,544 42 | 2,209 15 | 59,936 92 |
| Total Assets : Shs. 97,690/49 | | | Total Depreciations : Shs. 37,753/57 | | |

Schedule 2.

JOURNALS OF THE SOCIETY.

| 1936. | Shs. Cts. | Shs. Cts. |
|---|-----------|-----------------------|
| Jan. 1. Balance, as per last Balance Sheet ... | | 11,518 50 |
| Dec. 31. Cost of Printing further Journals ... | | <u>6,017 57</u> |
| | | 17,536 07 |
| Less Sales 422 00 | | |
| Free Issues during year ... 3,294 52 | | |
| Used in Exchange for Library additions 2,000 00 | | <u>5,716 52</u> |
| | | <u>Shs. 11,819 55</u> |

EAST AFRICA AND UGANDA NATURAL HISTORY SOCIETY.

PUBLICATIONS OF THE SOCIETY :

THE FOLLOWING BACK-NUMBERS OF THE JOURNAL ARE AVAILABLE :

| | | | | | | | |
|---------------|-----|-----|------------|------------------------------|-----|-----|-----------|
| Journal No. 3 | ... | ... | Shgs. 20/- | Journal No. 25 | ... | ... | Shgs. 5/- |
| " " 4 | ... | ... | " 20/- | " " 26 | ... | ... | " 6/- |
| " " 5 | ... | ... | " 20/- | " " 27 | ... | ... | " 6/- |
| " " 6 | ... | ... | " 20/- | " " 28 | ... | ... | " 5/- |
| " " 8 | ... | ... | " 10/- | " " 29 | ... | ... | " 5/- |
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| " " 13 | ... | ... | " 20/- | " " 33/34 | ... | ... | " 7/50 |
| " " 14 | ... | ... | " 20/- | " " 35 | ... | ... | " 7/50 |
| " " 15 | ... | ... | " 10/- | " " 36 | ... | ... | " 7/50 |
| " " 17 | ... | ... | " 5/- | " " 37 | ... | ... | " 7/50 |
| " " 18 | ... | ... | " 5/- | " " 38/39 | ... | ... | " 7/50 |
| " " 19 | ... | ... | " 4/- | " " 40/41 | ... | ... | " 7/50 |
| " " 20 | ... | ... | " 2/- | " " 42/43 | ... | ... | " 7/50 |
| " " 21 | ... | ... | " 4/- | " " 44 | ... | ... | " 7/50 |
| " " 22 | ... | ... | " 5/- | " " 45/46 | ... | ... | " 7/50 |
| " " 23 | ... | ... | " 5/- | " " 47/48 | ... | ... | " 7/50 |
| " " 24 | ... | ... | " 5/- | Vol. XII, Parts 1—6, each | ... | ... | " 7/50 |
| | | | | Vol. XIII, Parts 1 & 2, each | ... | ... | " 20/- |
| | | | | Vol. XIII, Parts 3—4, each | ... | ... | " 20/- |

MEMBERS OF THE SOCIETY ARE ENTITLED TO 20% DISCOUNT.

Members having any of the missing numbers in the above list and wishing to sell, are requested to communicate with the Editors.

THE FOLLOWING SEPARATA ARE ALSO AVAILABLE :

The Birds of Kenya & Uganda, Parts 1—9, Vol. I (van Someren) Shgs. 5/- each.
Parts 1—5, Vol. II (van Someren) Shgs. 5/- each.

NOTE :—The above are paged in sequence and suitable for binding in volumes. (Fully illustrated.)

The Butterflies of Kenya and Uganda, Parts 1—10 (van Someren) Shgs. 5/- each.
Part 1, Vol. II.
Supplement to Vol. I Shgs. 5/-

NOTE :—The above are paged in sequence and suitable for binding in volumes

THE FOLLOWING REPRINTS ARE AVAILABLE AT SHGS. 1/- EACH.

| | |
|--|-------------------|
| Notes on the marriage customs of the Kipsigis | (Orchardson) |
| Pest status of Coffee feeding insects | (le Pelley) |
| Fluvial Geology, etc | (Reck) |
| Mimicry, natural selection, etc. | (Carpenter) |
| Comparative series of skulls, etc. | (Leakey) |
| Religious beliefs of the Kipsigis | (Orchardson) |
| Nesting habits of some East Africa Birds | (McInnes) |
| Notes on Charaxes Pythodorus | (Evans) |
| Masai social customs | (Whitehouse) |
| Life histories of some East African Lept. | (Jackson) |
| The Age of the Rift Valley | (H. L. Sikes) |
| Marriage customs among the Masai | (Storrs Fox) |
| Luo marriage customs | (Shaw) |
| Cult of Mumbo | (Nyangweso) |
| Bride-Price, Nandi | (Huntingford) |
| Bantu of Kavirondo | (Owen) |
| Kikuyu Land Tenure, etc. | (Barlow) |
| Geographical distribution of animals | (Carpenter) |
| The Organic Cell | (Wynstone Waters) |
| Lumbwa Caves | (Hobley) |
| Report on the Bajun Islands | (Barton) |
| Captive mammals | (Loveridge) |
| Game disease | (Percival) |
| Notes on the Birds of Jubaland | (van Someren) |
| Masai Shields and Spears | (Storrs Fox) |
| Tribal Organisation of the Nandi | (Hemsted) |
| Notes on the Wasanye | (Champion) |
| Sedimentary Rocks | (Glenday) |
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SOME NEW TRYPETIDAE (DIPTERA) FROM KENYA.

By H. K. MUNRO., B.Sc., F.R.E.S.,

*Entomologist, Division of Plant Industry,
Union Department of Agriculture.*

Through the kindness of Dr. V. G. L. van Someren, I have been able to examine a series of reared fruit-flies in the collections of the Coryndon Memorial Museum. The material adds much to our knowledge of the host-plants of African Trypetidae, and is of interest not only on account of the new species discovered, but also as several South African species, such as *Pardalaspis marriotti*, Mro., *P. lobata*, Mro., *P. simi*, Mro., and others are included.

Dr. van Someren will publish general biological notes on the various species at a later date, while the new species are described here. The types will be deposited in the collections of the British Museum.

Dacus (Afrodacus) nigrivenatus, n.sp.

Allied to *Afrodacus biguttulus*,⁽¹⁾ Bez., from South Africa, but differs in various points: the face is unspotted, the frons wider, the scutellum uniformly coloured and no yellow hypopleural spot; the upper cross-vein is slightly infuscated.

Holotype male and allotype female, one male and two female paratypes, Nairobi, Kenya, 1936, N. Krauss. Reared from larvae in fruits of *Duranta repens*, Linn.

An entirely sub-translucent, orange-rufous species, with only the humeri and a broad mesopleural stripe yellow and the hind tibiae slightly blackened. Length: male, 5.5 mm., wing, 4.25 mm.; female, 6.0 mm., wing, 5.0 mm. *Head* normal, antennae a little longer than face, bristles black, only the four verticals and a single pair of inferior orbitals, the lower, rarely one or a very weak upper pair, superior orbitals and ocellars absent, genal weak. *Thorax* with pale pubescence and a pair of weak, pollinose, sub-median stripes. Bristles black, only outer cervicals, no anterior supra-alars but a pair of pre-scutellars. *Scutellum*, rather flattened convex above, sides and hind margin fairly straight, a pair of apical bristles. *Legs* normal. *Wing* normal, veins black, stigma, marginal cell, except a hyaline spot below end of first vein, a narrow costal stripe widened a little over end of third vein to middle of first posterior cell, a slight infuscation over upper cross-vein and anal stripe blackish. Anterior cross-vein below end of first vein and a little beyond middle of discal cell, lower cross-vein gently S-shaped. *Abdomen* with pale pubescence and third segment of male

⁽¹⁾ Bezzi. *Bol. Lab. Zool. Portici*, XV, 294, 1922, *Chaetodacus*, and *Ann. S.A. Mus*, XIX, 469, 1924, *Afrodacus*.

ciliate; segments apparently free. Male genitalia black. Base of ovipositor short, 1.0 mm., about equal to length of last two segments of pre-abdomen; flattened in specimens.

Dacus (Psilodacus) triater, n.sp.

A small black species closely allied to *maynei*, Bez.⁽²⁾ from which and others of the group it may be distinguished as the triangular disc of the scutellum is black.

Holotype male, allotype female, four male and three female paratypes, Naivasha, Kenya, June, 1936, H. J. A. Turner.

A black, elongate species with rather narrow wings, yellow head and legs. Length, both sexes, 5.5 mm., of wing, 5.0 mm. Head normal, somewhat spherical, only a little higher than long; occiput black above, below, well-developed and yellow; frons ferruginous on hind half, in front yellow with slight pale pubescence, ocellar dot black, two inferior and one superior orbital, no ocellars; lunule short; antennae one-third length of face, third joint largely blackish, arista bare; face with broad keel, epistome not prominent, cheeks narrow, genae about as wide as third antennal joint; proboscis and palpi yellow. Thorax punctate and black on dorsum, with pale, short pubescence, a pair of pale, dusted sub-median stripes, and also lightly dusted on sides. Humeri, a broad mesopleural stripe, single hypopleural spot and sides of scutellum yellow. Pleura ferruginous in front, otherwise black, with pale pubescence, long on sternites. Bristles black, only outer cervicals, no anterior supra-alar, and a pair of apical scutellars. Scutellum flat on disc, sides rather straight, the incurved apex narrow, about one-third length. Legs and halteres yellow. Wing three times long as wide, hyaline, with only stigma black, an elongate, costal spot on the end of third vein, and the upper cross-vein narrowly, slightly more in female, black-margined. Abdomen like dorsum of thorax, slightly reddish at end, pale whitish pubescence, almost parallel-sided, width about two-thirds length. Sternites small, brownish, with long pubescence in male, short in female. Male genitalia blackish. Base of ovipositor ferruginous, half as long and rather large in comparison with pre-abdomen, it is broad in proportion to its length, the basal half wide, and the whole, together with the large, semi-circular, sixth sternite, having the form of a short, wide, but flat, flask.

Pardalaspis contramedia, n.sp.

A curious species that seems to require the formation of a new genus or of a sub-genus. In general body colouration, especially of the dorsum of the thorax, and in wing-pattern, it resembles species of *Pterandrus*, such as *Pt. rosa*. The legs are simple, and, as in species

(2) See Collart, *Bull. Mus. r. d'Hist. nat. de Belgique*, XI, 6, 1935.

of *Pardalaspis*, the middle legs of the male do not present any feathering. The most marked feature is the shape of the head; while it is short, as is more characteristic of some species of *Trirhithrum*, it differs in having the frons rather strongly projecting before the eyes, the fronto-facial angle being only a little more than a right angle, and the lower occiput is more reduced than is usual in the last-named genus. It may be noted, however, that the shape of the head is somewhat variable among the species placed in the genera noted. In some species of *Trirhithrum* it is shortened, but in others it is more rounded or oval in profile. The typical shape in *Pterandrus* and in *Pardalaspis* may be said to be more or less squarish in profile; in some species of *Pardalaspis*, such as *P. lunata*, Mro., the head is short, but the frons is not prominent, and the lower occiput is more strongly developed than is usual in *Pardalaspis*. No other species of these genera has the arista so nearly bare as it is in this new species, but again, there is a gradation—in *Pardalaspis punctata*, Wied., it is short pubescent, while in many it is plumose. Other characters also need more comparison and it is intended to do this in later studies of this group of the *Trypetidae*.

Holotype male, allotype female, 22 male and 17 female paratypes, Nairobi, Kenya, December, 1936, V. G. L. van Someren. Larvae in fruits of *Warburgia ugandensis*, Sprague.

Length: male, 5.5 mm., of wing, 5.2 mm.; female, 6.0 mm., of wing, 5.5 mm. Small specimens have a wing-length of 4.0 mm. Head, proportions of length, height and width, about 4, 5 and 6. The eye is moderately large and about three-quarters long as high. Occiput flat and not very prominent below, yellow barely darkened above, the clothing below yellow, the bristles and orbital setulae black except the post-vertical bristles yellow. Frons flat, projecting before eyes, one-third width of head, one and three-quarters long as wide, widened anteriorly; dark yellow, brownish anteriorly in male, ocellar dot black, slight black pubescence medially in front, bristles black, two superior and two inferior orbitals, ocellars short, only a little longer than half the inferior orbitals. Lunule inconspicuous. Antennae large, brownish yellow, about as long as face, second joint not strongly spinulose above, third joint rather narrowed on outer half (not so marked in female), about two and a half times long as greatest width. Arista practically bare, only slight, scattered, microscopic pubescence on yellowish, basal third, flagellum black. Face yellow, with wide, shallow grooves, epistome moderately prominent, cheeks narrow, genae about as wide as third antennal joint, yellow, bristle black, as also a few setulae above it and those on sides of epistome. Proboscis and palpi yellow, latter with black setulae.

Thorax: dorsum brown as in species of *Pterandrus*, and with restricted black spots—a narrow, median black line, a dorso-central interrupted line consisting of a spot before, one on suture and one on dorso-central bristle, the last with a streak behind to join large pre-scutellar

spot. Laterally an indistinct spot before suture, above the wing-root a pair, one behind the other and separated from a wider streak above and which is also extended behind to join the pre-scutellar spot; pubescence black on spots, otherwise pale. Humeri yellowish, unspotted. Pleura and sterna light brownish-yellow with rather short, pale pubescence. Bristles normal, black, except the yellow cervicals, but the outer may be black, one mesopleural, dorso-centrals on line of anterior supra-alars. Scutellum semi-circular, not strongly swollen; basal third yellow with a small blackish spot on each side, the shining black hind two-thirds is incompletely divided from in front into three by two yellow streaks that only reach the apical bristles; in the female there is a moderate yellow spot on the underside. The upper part of the post-scutellum is shining black and divided by a median yellow spot, the pale brownish hind part is lightly silvery dusted. Squamae moderate with thickened, blackish rims. Halteres yellow. Legs simple; coxal bristles and clothing black, except hairs on upper part of front femora mostly yellow. Wing normal; rather narrowed outwardly, the stigma about three times as long as its greatest width; upper cross-vein just before inner third of discal cell and about opposite middle of stigma; basal streaks present and usual pattern, the marginal band broadly united to the basal, the cubital free and no medial, or only a bare trace.

Abdomen, ♂, brownish yellow, the second, third and fourth segments with their hind halves more or less broadly silvery dusted, the dust reaching the anterior edge in the middle, the anterior halves of the segments more brownish, with a pair of sub-median and a pair of sub-lateral brown spots, most marked on the fourth segment; pubescence black, but pale on first segment; strong marginal bristles present. Venter yellow. Genitalia yellow, the anal ring blackish. ♀, dorsum more generally silvery dusted all over, more strongly on hind margins of segments and on median line, the brown spots are very slight or absent on third segment, usually strong and of moderate size on fourth, but the outer ones may be absent, slight or absent on fifth; sixth segment very short. Base of ovipositor long, about as long as pre-abdomen, yellow, flattened in specimens, pubescence on anterior third pale, black behind.

Pardalaspis simi, Mro.

Munro, Union Dept. Agr., Ent. Memoir 8, p. 37, Pl. III, f. 10, 1932.

Three males and two females reared from larvae in fruits of *Acokanthera longiflora*, Staff (Nairobi, 1936, N. Krauss) and a male and three females from *A. schimperi*, Schweinf. (Nairobi, April, 1937, van Someren) are placed in this species. After comparison with the types there does not seem to be any difference except the greater size of the Kenya specimens; in these the length of the male is 6.2 mm.,

of the female 6.5 mm., and of the wing in both, 6.5 mm., while in the types the male is 5.0 mm., the female, 6.0 mm., the wing in both, 5.8 mm. However, two females from Cedara (Jan., 1933, Entomologist, bait trap) and a female from Kokstad (13/3/33, H. Eagle, bait trap) are larger, having a wing-length of 6.0 mm. Further, in the South African specimens there is nearly always a small, but strong, oval black spot on the middle of the dorsum of the thorax, while in the Kenya specimens this is usually weak or absent, especially in the females.

It may be added here that although *P. simi* seems to resemble *P. stictica*, Bez., the likeness is probably quite superficial, but I have not yet seen specimens that I can consider to be *stictica*. However, the latter is a small species with plumose arista, like *P. giffardi* and others, while *simi* is a large, yellow species with pubescent arista.

Pardalaspis turneri, n.sp.

A small species allied to *Pardalaspis aliena*, Bez.⁽³⁾. It differs in having the antennae blackish-brown, not yellow, as also the upper two-thirds of the face; on either side of the broad, median, yellowish stripe, the dorsum of the thorax is continuously dark brown, and the base of the wing is distinctly blackish.

Holotype male, allotype female, 11 male and 10 female paratypes, Naivasha, Kenya, June, 1936, H. J. A. Turner, and one male paratype, Ngong, Kenya, June, 1936, V. G. L. van Someren. Those from Naivasha were reared from larvae in fruits of *Solanum nodiflorum*, Jacq.

Length: male 4.0 mm., female 4.5 mm., of wing in both 4.5 mm. (in a small male, 3.5 mm.). *Head*: proportions of length, height and width, 3, 4, and 5; the upper part of the frons, the vertex and upper occiput yellow, the last blackish, head otherwise pale whitish yellow, with black ocellar dot and brown upper two-thirds of face. *Frons* flat, parallel-sided, a little longer than wide, and two-fifths width of head, a little pale pubescence in middle; bristles, two superior and two inferior orbitals, ocellars strong, the rest of the clothing of the head in male yellowish, but in female genal bristle and a short row of setulae on sides of epistome black. The vertical plates are broad and shining, reaching the middle of frons. *Lunule* inconspicuous. *Antennae* brown, the third joint strongly blackish; arista short plumose. *Palpi* and *proboscis* pale yellow. *Cheeks* narrow, *genae* wide, about one-third height of the rather small, rounded-oval eye. *Thorax*: dorsum with pale pubescence, a little black in front; a broad, median chestnut stripe as wide as distance apart of pre-scutellar bristles, it is very slightly (less than in *aliena*) dusted anteriorly except a slight median streak, and behind has a more or less developed median, ivory yellow streak broadly widened behind; the sides of the

(³) Bezzi. *Bull. Ent. Res.*, X, 231, 1920.

dorsum are broadly and more or less uniformly dark, shining, brownish-black, there is an ivory yellow notopleural spot and, above the wings, behind the suture, a streak, ivory yellow in front, chestnut behind where there is a tooth to the outer posterior supra-alar bristle; humeri pale yellow. Pleura whitish-yellow, with long, pale hairs, sterna rather more yellowish and with long, dense, pale hairs below. Bristles normal, black, except yellow middle scapulars and pale yellow sterno-pleural; one mesopleural, dorso-centrals a little behind anterior supra-alar. *Scutellum* not strongly globose, only moderately convex, with four bristles, the apicals rather close together, slight pubescence, the disc mostly ivory yellow, with the usual three quadrate spots marginally, the apical one somewhat small, they are edged with yellowish, and tend to coalesce in front; upper part of post-scutellum entirely black, the lower reddish-yellow with whitish dust. *Legs* simple, with yellow clothing, a black spur at end of middle tibiae, in female the stronger bristle-hairs are black. *Wing* almost as in *aliena*, both the cubital and medial bands are united to the separated marginal; the bands are blacker than in *aliena*, and the base of the wing definitely black; the upper cross-vein is a little before the middle of the discal cell. *Halteres* yellow. *Abdomen* normal: first two segments yellowish, otherwise blackish-brown, second segment with slight and fourth with stronger silvery margin on hind edge, in female a slight silvery spot on hind edge of third segment; pubescence rather long, mostly yellow, black on sides of second and between second and third segments, otherwise only a little black on hind margins of segments, marginal bristles black; in female rather more black pubescence and stronger bristles on edges of segments. *Venter* and male genitalia yellowish. In female sixth segment very short. Base of ovipositor yellow, with black pubescence, flattened in specimens, slightly shorter than fourth and fifth segments together.

Pterandrus curvatus, n.sp.

A blackish species, probably allied to *Pardalaspis pedestris*, Bez., and to *P. lobata*, Mro., but differing as the middle legs of the male are feathered. In the absence of specimens, it is not possible to say just how closely it may be allied to *Pterandrus pinnatifemur*, End.,⁽⁴⁾ in which, as in this species, only the middle femora are feathered. Enderlein's description is very brief, but as he compares his species with *Pterandrus anonae*, Grah., it may be assumed that the feathering on the middle femora is as in Graham's species, that is, on the lower edge, but the latter has also the middle tibiae feathered. In *curvatus* the feathering is on the upper edge at the apex of femora. *Pt. curvatus* is probably more nearly allied to *Pt. podocarpi*, Bez.⁽⁵⁾ The two are very similar, but in *podocarpi* only the middle tibiae are feathered. The

(4) Enderlein. *Zool. Jahrb.*, 43, 353, 1920.

(5) Bezzi. *Ann. S.A. Mus.*, XIX, 476, f. 22, 1924.

notopleural band is much narrower, and while the hairs on it are also yellowish, they do not extend so markedly on to the pteropleural region as in *podocarp*i. In *curvatus* the black scutellum is not divided into "quadrate" areas. Various differences in the colouration of bristles and hairs between the sexes in *curvatus* may be noted.

Holotype male, allotype female, one male and two female paratypes, Nairobi, Kenya, December, 1936, three male and two female paratypes, Jan., 1937, van Someren; five male and three female paratypes, Nairobi, June, 1936, van Someren. (All reared from larvae in fruits of *Strychnos usambarensis*, Gilg.; the June specimens are undersized and rather teneral.) One male paratype from *Acokanthera schimperi*, Schweinf., Karura, June, 1936, van Someren, appears to be identical with the specimens from *Strychnos*.

Head yellow, proportions of length, height and width, 7, 10, and 13; *occiput* black above, more or less extensively yellow at vertex, pale yellow below with yellow hairs, moderately swollen. *Eye*, relatively large, about twice as long as wide. *Frons* parallel-sided, about one and a half times long as wide, flat, whitish, yellow at vertex, ocellar dot black, an irregular brown mark across middle, much stronger in female, and at antennae, the latter mostly as lateral spots in male, but wider and crossing top of face in female; slight black pubescence; bristles black and normal, two superior orbitals, two lower, ocellars strong. *Lunule* inconspicuous. *Antennae* about three-fourths length of face, straw-yellow in male, brown in female; arista rather short plumose, stronger in female. *Face* pale yellow with shallow grooves, and, as noted, a brown bar across top in female; cheeks and genae pale yellow, the latter with a large brown spot below the eye in female, clothing yellow but a rather weak row of setulae on sides of epistome in male, stronger in female; proboscis short, brown, palpi yellow in male, brown in female. *Thorax* dark; dorsum shining brownish-black, a pair of ivory yellow, rather small spots before scutellum; pubescence white, black on sides and above humeri, longer on middle line behind; silvery dust forming a pair of wide sub-median stripes from front edge, uniting behind on line of dorso-central bristles and then narrowing to a point on hind edge, and a pair of sub-lateral inwardly curved stripes, bent inward before suture to join the sub-median stripes. *Pleura* light blackish-brown, with upper pale stripe, light brown on humeri, which have a large brownish spot, and propleura and on base of wing, yellow on upper half of mesopleura. The pubescence on the yellow bar is yellowish, on the propleura a row of whitish bristle-hairs, otherwise pubescence pale and inconspicuous, with some stronger and black below the mesopleural bristle, some forming a definite perpendicular row; at the bottom of the mesosternites long and whitish, with a few black hairs; in the female there is more black on the lower mesopleura, and the long hairs on the mesosterna all black. *Scutellum* swollen, almost

spherical, shining black with sparse pale pubescence; across the middle of the base is a yellow, forwardly curved bar, with a pair of disconnected yellow spots at the sides, but the middle bar may be absent, or only a trace, or well developed and connected with the lateral spots. There is a single, shining whitish hypopleural spot with a slight brownish streak across its middle; the post-scutellum is shining black, the lower portion covered with dense, silvery dust, below the scutellum being a lenticular yellow cross-bar. Bristles black: dorso-centrals a little behind line of anterior supra-alars, the middle cervicals strong, a single mesopleural, and four scutellars. *Wing*, male, length 4.5 mm. by 1.9 mm. at greatest width, in female 4.75 mm. by 1.9 mm. Pattern with usual basal spots and bands, these being all black with only a trace of yellow in upper part of basal band in male; marginal broadly united to basal, cubital free and no medial; the third vein setulose to outer third of first posterior cell; costal bristle weak; lower cross-vein, before middle of discal cell, is three and a half times its length from the lower; discal cell with upper and lower sides parallel, and the outer, lower angle acute; the alula and third anal cell large and semi-circular, rather less in female. *Legs*: male, all coxae brown; front femora swollen, yellow, blackened above, with dense yellow and some black hairs, on inner ventral edge a row of long, shining yellow, close-set hairs for whole length, on the outer edge a row of less closely-set, black bristle-hairs; middle femora yellowish on basal third, blackish outwardly, the anterior surface densely covered with coarse setulae, below, on the distal two-thirds and on the posterior side of the tibial groove, a row of black bristles, above, on distal third, a short row of feathering, its length about the diameter of the femur, shortening rapidly to very short at apex; hind femora mainly blackened, yellowish at base, clothed with black setulae, apically below with a short row of short bristles on each side of tibial groove, those on anterior side being almost feather-like, apically above an irregular group of outwardly bent bristle-hairs; all tibiae and tarsi yellow, hind tibiae with a row of setulae on middle half of outer surface, mid-tibiae with single apical spur. In female, coxae brownish, femora brown, yellowish basally, clothing black, tibiae and tarsi yellow, front femora with row of strong bristles below, hind with irregular series of apical bristles above as in male; hind tibiae with row of moderate setulae on upper outer surface, middle with weaker row. Halteres brown. Squamae, upper large, rounded, lower less rounded, both semi-transparent with thickened brownish rim set with fine hairs. *Abdomen* normal, brown, first and fifth segments blackish-brown, third almost quite black, second with moderate silvery dusted bar, yellowish anteriorly, fourth also with silvery bar, brown anteriorly; pubescence black, whitish on silvery areas. In female generally browner, silvery bars narrower. Base of opivisor short, somewhat longer than segments four and five together, black on hind half, reddish-yellow anteriorly, pubescence

black, sides of fourth and fifth segments and hind edge of barely visible sixth with black bristles. Male genitalia brown. Venter brown.

Pterandrus gravinotatus, n.sp.

A species in which only the middle tibiae of the male are feathered; it differs from other recorded species of *Pterandrus* in the heavily marked wing-pattern, especially the very strong medial band united to the marginal. The species, however, seems to be very like *Pardalaspis cyanescens*, Bez.⁽⁶⁾ described on a female from Madagascar. The female of this new species differs in having the third antennal joint brown, not yellow, a pair of yellow pre-scutellar spots on the dorsum of the thorax in both sexes, and the brown abdomen with the second and fourth, also fifth in female, segments almost entirely and very strongly silvery dusted. From *podocarpi*, Bez., it differs, apart from the wing-pattern, as the black of the scutellum is not divided into quadrate areas.

Holotype male, allotype female, six male and twelve female paratypes, Nairobi, Kenya, December, 1936—January, 1937, V. G. L. van Someren. Larvae in fruits of *Podocarpus gracilior*, Pilger.

Length: male, 4.0, wing, 4.5 mm.; female, 5.25 mm., wing 5.0. *Head*, proportions of length, height and width, 7, 11, and 12, relatively slightly larger in male; *occiput*, flat, not very prominent below, yellow, blackish above on sides; *frons*, in male, yellow, darker above, dark brown ocellar dot, slight yellow pubescence in front; in female brownish, yellow around lower inferior orbital bristle, ocellar dot blackish, and brown pubescence, especially on sides, in both sexes, parallel-sided, width about two-thirds length, somewhat swollen before eyes; *lunule* inconspicuous; *antennae* about as long as face, yellow in male, brown in female, arista short pubescent; *face* flat, yellow, in male a brown spot below eye; in female, cheeks also brownish; palpi and proboscis yellow.

Thorax: dorsum shining black, with slightly dusted pattern on disc where pubescence is pale, otherwise black that is, on sides, in front and on undusted median streak and pair of dorso-central spots on suture, and a pair of ivory yellow, rather small, pre-scutellar spots; bristles black, one mesopleural, inner and outer cervicals, dorso-centrals about on line of anterior supra-alars. Humeri yellow with large blackish spot. Pleura, upper two-thirds white with pale pubescence, lower portions and sterna brown with black pubescence, except where pale pubescence extends from above on to pteropleura; a double, white, hypopleural spot. *Scutellum* shining black with black pubescence, an ivory yellow

(⁶) Bezzi. *Bull. Mus. Hist. nat. Paris*, XXIX, 529, 1923.

bar across the base, the middle, curved portion with its arm reaching about half length of scutellum to apical bristles; four scutellar bristles. Post-scutellum shining black, the hind portion thickly silvery dusted. *Legs*: clothing mostly black, front femora black, rather swollen with dense black, bristle hairs, tibiae and tarsi yellow; middle legs in male yellow, but outer two-thirds of middle tibiae black, and on their outer half, feathering on both sides; in female, middle legs simple, femora and tibiae brownish, tarsi yellow; hind legs brown, tarsi yellow, femora with short row of setulae below at end, tibiae with strong row of setulae on upper side. *Wing* normal, upper cross-vein slightly before middle of discal cell; pattern black, rather weaker in male, anal band moderate, rather few hyaline streaks and dark spots, marginal band with usual hyaline costal edge and black spots, narrowly or barely joined to basal in sub-marginal cell, end of stigma hyaline, cubital band free, medial strongly united to marginal and reaching wing margin. *Squamae* rather large. *Halteres* brown. *Abdomen* brown with black pubescence; second segment, whole of fourth except narrow anterior edge, and hind half of fifth thickly silvery dusted (in male, fifth only lightly dusted), the brown fore edge of fourth segment may more or less form spots. Male genitalia and venter brownish. Base of ovipositor short about as long as fourth and fifth segments together, reddish, outer third brown, black pubescence.

Trirhithrum queritum, n.sp.

Four specimens reared from larvae in the fruit of a species of *Strychnos usambarensis*, Gilg. (Nairobi, 1936, N. Krauss) have the base of the wing with a weak anal band and rather strongly developed hyaline streaks and black spots; added to the fact that the cubital band is strongly united to the basal, the species comes closest to couplet 20(15) in my review of the species of *Trirhithrum*.⁽⁷⁾ The question may be raised as to whether or not it may be *bimaculatum*, v. Röd.,⁽⁸⁾ but this cannot be stated with any certainty, as, from available data, v. Röder's species cannot be recognised till the type has been re-examined. I would thus even qualify my previous statement⁽⁷⁾ in regard to the correctness of Enderlein's determination as *bimaculatum* of a specimen from Spanish Guinea. The recorded presence of only two scutellar bristles, already queried by Bezzi, is problematical; in all probability two have been abraded in the type. The scutellum is stated to be shining black, and no mention is made of any yellow mark on the disc. Finally two grey marks are recorded on the margin of the third segment; the type is a female.

⁽⁷⁾ Munro. *Bull. Ent. Res.*, XXV, 476, 1934.

⁽⁸⁾ v. Röder. *Berl. Ent. Zeit.*, 29, 135, 1885, *Ceratitis*.

⁽⁷⁾ Munro, l.c., p. 479.

The chief differences between *queritum* and *viride*, Mro. (l.c.) are the wider frons, in *viride* only a quarter the width of the head, and the presence of a white mark across the base of the scutellum, absent in *viride*.

My tables (l.c.) may therefore be amended as follows : to couplet 13(55) add " or a white or yellow curved bar across the base," and to 20(15) " or rarely absent." Then :—

- 22(23) Thorax entirely black *bimaculatum*, v. Röd.
23(22) A white notopleural stripe of greater or less extent from humerus to wing-base.
a(b) Frons narrow, a quarter the width of the head, scutellum black. *viride*, Mro.
b(a) Frons one-third width of head, scutellum with white bar across base. *queritum*, n.sp.

Holotype male, allotype female and two female paratypes.

Length : male 4.0 mm., female 4.5 mm., of wing in both 4.0 mm. *Head* normal, proportions of length, height and width, 3, 4.5, and 5.5; *occiput* light yellow, brownish above, moderate below; *frons* slightly more than one-third width of head, flat, yellow, black ocellar dot, slight black pubescence, bristles black, two superior, two inferior orbitals, ocellars moderate; *lunule* short, a brown bar across it from side to side; *antennae* brown, a little shorter than face, arista short plumose; *face* flat, whitish, cheeks narrow, genae brown with black bristle and setulae; proboscis and palpi light brownish. *Thorax*: dorsum shining black, on disc with slight dust on which pubescence is white, pubescence black on sides and in front, also on undusted median stripe and pair of round dorso-central spots on suture, a pair of small, round prescutellar white spots on dorso-central line. *Humeri* yellow with large black spot. *Pleura* and *sterna* brownish-black, upper half of mesopleura lighter brown, margined with a yellow stripe above and below. A single yellow hypopleural spot with an irregular brown bar across it. *Scutellum* shining black with black pubescence, base with sides yellow and a yellow, forwardly curved stripe across top. Post-scutellum black, upper part shining, lower dusted. *Halteres* brownish. *Legs* simple, coxae yellowish, femora and inner four-fifths of middle tibiae black, otherwise yellow. *Wing* normal, moderate anal band reaching to middle of alula, separated from basal by hyaline streaks and brown spots, stigma quite black, wide marginal and cubital bands broadly united to basal, no medial; upper cross-vein before middle of discal cell, end of fourth vein straight. *Abdomen* brownish black, hind edge of second broadly and whole of fourth segment except narrow anterior margin thickly silvery dusted, and in

female middle of fifth lightly dusted. Pubescence black, some white on middle of fourth segment in female. Male genitalia black. Base of ovipositor short, about length of segments four and five together; black with black pubescence.

Schistopterum moebiusi, Beck.

Becker, *Mitt. Zool. Mus. Berlin*, II, 137, 1908.

Efflatoun, *Mém. Soc. R. Ent. d'Egypte*, 2, 72, Pl. I, ff. 2 and 10, Pl. III, f. 5, 1924.

Specimens reared from a composite plant at Naivasha—March, 1937, H. J. A. Turner—are rather larger than those I have seen from Egypt and from South West Africa, but are otherwise similar. They are also blacker, but this is probably as they are still fresh. A comparison with the following new species is given below.

Schistopterum longulum, n.sp.

This new species is represented by a few specimens reared from flowers of the composite plant (not yet determined) at Naivasha, Kenya, in March, 1937, by H. J. A. Turner—holotype male, allotype female, two male and three female paratypes. It is very like *S. moebiusi*, but the two may be distinguished by the characters in the table that follows. To some extent the new species agrees closely with the description given by Efflatoun (l.c.) of *S. moebiusi*, so that the list of contrasted characters and the additional notes will be sufficient here.

| | <i>moebiusi</i> | <i>longulum</i> . |
|---------------------------------|---|--|
| | Smaller: wing-length 1.75 mm. (Kenya specimens, 2.1 mm.) | Larger: wing-length 2.5 mm. |
| Shining black ocellar triangle. | Shorter and broader; about half length of frons. | More elongate; about two-thirds length of frons. |
| Palpi. | Narrower, outer third black. | Broader, outer half black. |
| Third antennal joint. | Distinctly short; about $2\frac{1}{2}$ times long as wide, and $1\frac{1}{2}$ to twice length of second joint; partly yellow. | Distinctly long, about four times long as wide and three times length of second. Almost quite black. |
| Dorsum of thorax. | With scattered, coarse, white pubescence ("appressed hairs"—Efflatoun). | With less, but fine, white pubescence. |
| Dorsum of abdomen, female. | No row of white hairs along hind edge of fourth segment. | Such a row present—see further note. |
| Base of ovipositor. | About half length of pre-abdomen. | About five-sixths length of pre-abdomen. |

The outer half of the third antennal joint is only about half the width of the inner, but the apex is not sharply pointed. The black of the body coloration tends to be more ferruginous, especially on the legs, in teneral specimens. The wing-venation and pattern is closely similar to that in *moebiusi*. In the latter it may be noted that the bright yellow spot is circular and the black bar on its outer and lower sides—forming the letter J—has the tail curved round, whereas in *longulum* they are opaque, shining, black, but in more teneral specimens they appear pale and greyish or semi-transparent; in teneral specimens of *moebiusi* they are reddish. On the dorsum of the abdomen of both species there is a little, deciduous, white pubescence, while in the female of *longulum* is formed a more permanent row on the hind margin of the fourth segment.

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A. F. J. GEDYE.

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EDITORIAL.

The attention of members is invited to the desirability of publishing short notes in the Journal. Members are requested to contribute notes and observations on natural history subjects as it is considered this will make the Journal of more local interest to those resident in East Africa. Records of the occurrence of the less common mammals, birds, reptiles, insects, etc., will be welcomed.

A certain confusion has arisen in the past owing to the method adopted of dating the Journal. This has been due to the Society's endeavour to issue four parts a year. It is now proposed to print only one date on each issue which will be the date of publication. With the present issue the former system of giving a serial number to parts is resumed. This will facilitate reference and below are given the serial numbers which should apply to parts recently issued with only the volume number.

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NEW TRYPETIDAE FROM KENYA COLONY.

II.

By H. K. MUNRO, B.Sc., F.R.E.S.,
*Entomologist, Division of Plant Industry,
Union Department of Agriculture.*

In the following pages are described further new species of Trypetidae reared and collected in Kenya Colony by Dr. V. G. L. van Someren. In the case of two of the species specimens from other sources have been included.

The types are to be located in the collections of the British Museum.

Dacus (Psilodacus) umbrilatus, n.sp.

Apparently very like *annulatus*, Beck., but with a weak or no pteropleural bristle (strong in *annulatus*, teste Bezzi) and the distance between the ends of the second and third veins equal to that between the third and fourth (the former only one-third the latter in *annulatus*).

Holotype ♂, allotype ♀, 8 male, 13 female paratypes, Ngong (Nairobi), December, 1937 (No. 481), and 8 male, 11 female paratypes, Rabai, Kenya, August, 1937 (No. 340) van Someren: all reared from larvae in pods of *Marsdenia*, sp. not yet determined (Asclepiadaceae).*

Length, male 6.5 mm., of wing, 5.5 mm.; female 6.5 mm., of wing 6.0 mm. HEAD: occiput ferruginous above, a yellow spot behind vertex, yellow below, narrowly on orbits above, becoming wide below; frons about one-fourth width of head, parallel-sided, shining yellowish-brown, brown at vertex, on middle and a spot on each side of lunule (in some specimens the brown on middle extends more or less irregularly for most of the length), ocellar dot black, pubescence pale; bristles: a pair of short, black, inferior orbitals at antennae, and a pair of weak, paler ones about middle, single superior orbital and ocellars short and weak; lunule black; antennae about as long as cheeks, ferruginous, third joint blackish, less so on inner side; face yellow with large, median, triangular, brown to black spot touching antennae

* It is possible that these two *Marsdenia* are not the same species—that from Rabai growing at practically sea-level (700 feet) and those from Ngong at 6,800 feet.—(van Someren.)

above but not quite reaching epistome below, on sides touching inner edges of grooves, sometimes less extensive in male, and in female generally of still less extent or reduced to a spot below antennae; palpi and proboscis yellowish; genal bristle yellow. THORAX: dorsum finely punctate, dull black, covered with slight white dust except on median strip and faintly on dorso-central lines behind suture; on the sides, above humeri and of greater or less extent is a ferruginous spot, touching the humeri anteriorly, behind there is a ferruginous spot on the suture and, above the wing base, as a more or less ferruginous area, somewhat visible from above, or the supra-humeral spot may be continued backwards as a definite stripe, obliquely across the suture and then as a more definite stripe above the wing-base; humeri yellow, a broad yellow mesopleural stripe, extended below as a large spot on the sternite but not crossing notopleural suture above, only inner ends of suture yellowish; the single, large, oval hypopleural spot is yellow on its upper three-fifths; propleura rather light ferruginous, otherwise pleura black, also sternites and post-scutellum, pubescence white; bristles: no anterior supra-alars nor mid-scapulars, pteropleural absent or a weak, yellow, bristle-hair; scutellum yellow, with fairly wide ferruginous base, the extreme base black, the pair of apical bristles three-fourths length of scutellum apart; legs: coloration pale in specimens, may be darker normally; inner two-thirds of femora yellow, outer ends brown (light ferruginous), on front legs tibiae and tarsi brown, on middle pair paler and still more so on hind pair on which middle part of tibiae also yellow; halteres yellow; squamae whitish with brown edges; wing: stigma, marginal cell, narrow costal stripe and spot at end of third vein black, base of sub-marginal barely infuscated, no anal stripe, point of anal cell as long as rest of sixth vein, and no distinct cloud at end of the vein in male. ABDOMEN: the segments fused; black, the large yellow fascia on second segment narrowly divided in middle and not reaching sides of segment; on first segment a ferruginous patch in centre and this may include whole segment; on third to fifth segments there is a trace of ferruginous in middle, in some specimens more extensive, but a median black stripe is always present; the pair of apical areas ferruginous to yellow; base of the ovipositor short, ferruginous, length 1.4 mm.

Most of the specimens are rather teneral, the series No. 340 most so and under-sized and under-coloured, the abdomen much shrunken. The series No. 481, from which the types have been selected, are better coloured but still rather teneral. Among them, however, are four females apparently well-hardened and the abdomen in good shape, but with the yellow mark discoloured. In these the abdomen is flat oval, the sixth segment ferruginous, the base of the ovipositor legging-shaped, length 1.5 mm.; sternites black. The total length about 8.0 mm., of the wing 6.25 mm. The spot at the tip of the wing in most has a short hyaline streak in the end of the sub-marginal cell.

Dacus (Didacus) ostiofaciens, Mro., var. *tenebricus*, var. nov.

The specimens agree so closely with *D. ostiofaciens*, Mro.,* that it seems best to regard them as a variety; the base of the ovipositor is relatively somewhat longer and there are a few other smaller points to be noted.

Holotype male, 10 male and 10 female paratypes from larvae in pods of *Asclepias integra*, Naivasha, Kenya, June, 1937, 5 male and 14 female paratypes from *Asclepias semilunata*, Naivasha, Kenya, June, 1937; 1 male and 4 female paratypes from *Asclepias kaestneri*, V. G. L. van Someren. Allotype female, 19/9/34, and one female paratype, 10/1/35, Kampala, Uganda, H. Hargreaves, from pods of *Asclepias semilunata* ("kafumbo"); one female paratype, Entebbe, Uganda, 29/1/10 (No. 1663).

Length 8.0 mm., of wing, 6.0 mm. Agrees with description of *ostiofaciens* and the following points may be noted: Two inferior and one superior orbital bristles; the facial spots rather larger; humeri and a moderately wide mesopleural stripe from top edge of sternite to dorso-central line, yellow; scutellum yellow, the base narrowly ferruginous, more appreciably so in *ostiofaciens*; wing: inner end of sub-marginal cell broadly black like stigma, in *ostiofaciens* only infuscated, the rest of the cell and the marginal light brownish with a moderate oval spot on end of third vein; anal stripe strong. In the female from Entebbe, the first basal, inner half of first posterior, discal and third posterior cells yellow hyaline, and somewhat darker infuscation over upper cross-vein. The tip of the base of the ovipositor is distinctly visible beyond end of abdomen, and is about two-fifths its length relatively longer than in *ostiofaciens*.

Dacus (Didacus) vansomereni, n.sp.

A striking species much like *vertebratus*, Bez., but distinguished from this and from other species with well-developed yellow markings by the three strong, post-sutural yellow stripes; *venenatus*, Mro., has also such stripes, but no humeral nor hypopleural yellow spots.

Holotype ♂, allotype ♀, 4 ♂ and 5 ♀ paratypes, Rabai, Kenya, August, 1937, van Someren, reared from larvae in fruits of *Adenia*, sp. not yet determined (Passifloraceae).

The material includes three larger specimens like the female type, the others smaller like the male type. Length, ♂ 6.5 mm., of wing, 5.25 mm., female, 8.5 mm., of wing, 6.5 mm. HEAD of usual shape, pale ferruginous, occiput broadly yellow on orbits, ocellar dot black, vertex ferruginous on each side, frons with large brown spot on centre and usual sub-integumentary spots at bristles, silvery sheen obliquely, slight black pubescence in front, pale behind, two inferior and one

* Munro, *Stylops*, I, 158, 1932.

superior orbitals, no ocellars, lunule black; antennae rather long, second and third joints together a little longer than cheek, first joint half length of second and one-fifth length of third, the width of last being rather less than one-fifth its length and more or less blackened; face with pair of broad, oval black spots which may be somewhat pointed above and below, the grooves yellow, cheeks silvery along orbits; palpi and proboscis yellow. Thorax ferruginous, dorsum faintly whitish dusted, with usual median and dorso-central bare stripes, pubescence yellow, three strong, post-sutural yellow stripes, the middle one more or less black on each side, the outer ones black on the inner side, in the males the black is stronger, leaving only a dorso-central ferruginous stripe on each side, and continued forward as a median stripe; humeri, a moderate mesopleural stripe touching sternite below and notopleura above, single hypopleural spot, and scutellum yellow, the last with narrow ferruginous base, pubescence white; bristles: mid-scapulars present, no anterior supra-alars nor pteropleural, one mesopleural and pair of apical scutellars; legs brownish, only metatarsi and inner two-thirds of femora yellow; wing: stigma, marginal cell and sub-marginal past end of second vein blackish, there being only a poorly defined spot on the end of third vein, the upper edge of sub-marginal cell, before end of second vein, yellowish; anal stripe strong, point of anal cell rather wide, in male three times and in female not quite twice length of rest of sixth vein, below end of which in male a slight cloud; last section of fourth vein strongly sigmoid. *Abdomen* ferruginous with strong median black stripe which divides the fascia on hind half of second segment; posterior areas yellowish; in the males the abdomen is largely black, more or less ferruginous in the middle, but with median black stripe; pubescence whitish, short; third segment in male ciliate; genitalia blackish; base of ovipositor short, 1.0 mm., barely projecting.

Dacus (Dacus) ambliquus, n.sp.

Allied to *telfaireae*, Bez., from which it differs in having all femora partly yellow, and to *purus*, Curr., but has a strong and complete costal stripe on the wing.

Holotype ♂, allotype ♀ and two ♂ paratypes, Rabai, Kenya, August, 1937, van Someren, taken on bait.

Length, ♂, 7.3 mm., ♀ 7.5 mm., on wing in both 6.0 mm. **HEAD**: occiput ferruginous, moderately yellow along orbits; frons about one-fourth width of head, yellow, brown across vertex and around black ocellar dot, orbital spots strong and a large rounded spot in middle touching middle pair of spots, slight black pubescence in front, pale behind, the two inferior and single superior orbitals short, no ocellars; lunule black; antennae ferruginous, first joint yellow at base and about as long as second, second and third together about as long as cheeks;

face with a large round, black spot on each side and a brown spot below eye; palpi and proboscis brownish. THORAX ferruginous, more or less black, dorsum with pale yellow pubescence, dorsum before suture black on sides and a median blackish stripe, behind the suture, more or less extensively black between the three narrow, yellow stripes; humeri ferruginous with a diagonal, narrow, yellow stripe from anterior outer corner to posterior inner corner; mesopleural stripe moderate, a single hypopleural spot and scutellum yellow, the latter with a wide ferruginous base; pleura blackish ferruginous; bristles: anterior supra alars and mid-scapulars present, pteropleural strong, the single pair of apical scutellars the length of scutellum apart; halteres whitish; legs ferruginous, only metatarsi, the proximal third of fore femora and proximal two-thirds of other femora yellow, the four front femora are obliquely marked, the upper surface being more yellow than the lower; wing: costal stripe strong, black, filling stigma, marginal cell and sub-marginal from end of second vein and extending over end of third vein nearly to middle of first posterior cell to form a moderate but not very strongly marked apical spot; point of anal cell wide and somewhat parallel-sided, in male two and a half times, and in female one and a quarter times as long as rest of sixth vein, below end of which a slight cloud in male; last section of fourth vein gently sigmoid. ABDOMEN ferruginous, yellowish along middle, but with a median ferruginous stripe; yellow fascia on second segment strong; third segment in male ciliate; pale yellowish pubescence rather long; genitalia and sternites ferruginous; base of ovipositor very short, 0.75 mm., barely projecting.

Dacus (Metidacus) pergulariae, n.sp.

A rather more reddish species than *lotus*, Bez., and at once distinguished from it by the very broad mesopleural stripe; the third segment in the male is very weakly ciliate.

Holotype ♂, allotype ♀, 4 ♂, 12 ♀ paratypes, Rabai, Kenya, August, 1937, van Someren, reared from larvae in pods of *Pergularia*, sp. not yet identified.

Length, male, 7.0 mm., of wing, 5.5 mm.; female, 7.5 mm., of wing, 5.75 mm. A light ferruginous species. HEAD more yellowish, with black ocellar dot and the usual sub-integumentary spots on sides of frons; frons a little more than one-fourth width of head, some slight, fine, black pubescence, one superior and two inferior orbitals; antennae of normal length; face unspotted, yellow in female, the grooves yellow in male. THORAX: on dorsum pale pubescence and a pair of slightly dusted, sub-median stripes; humeri, broad mesopleural stripe (most of mesopleura), spot on sternite and single hypopleural spot yellow, also scutellum which has narrow ferruginous base; bristles: anterior supra-alars present, no mid-scapulars, only apical

scutellars which are four-fifths length of scutellum apart (in one specimen there is a single, super-numerary bristle near the scutellum on the dorso-central line). Legs yellow, outer ends of femora barely darkened in these specimens, also inner end of middle tibiae, hind tibiae brown, ends of tarsi darkened; halteres yellow; wing: stigma black, marginal cell blackened and a narrow costal stripe to spot at end of third vein, filling tip of sub-marginal cell which is otherwise hyaline (in *lotus* marginal and sub-marginal cells yellow hyaline to end of second vein), anal stripe slight, point of anal cell narrow, in male as long as rest of sixth vein, in female a little shorter, no cloud at end of sixth vein in male. ABDOMEN rather elongate, more or less mottled black, but this may be due to discoloration; pubescence pale; third segment in male very weakly ciliate, the ciliae only just differentiated from other marginal hairs and of same pale colour, no alveoli apparent. Male genitalia ferruginous, also venter which is yellow at base; base of ovipositor flattened in specimens, about 1.0 mm. in length.

Perilampus curta, n.sp.

A species very like *dimidiata*, Bez., but with the base of the ovipositor short, differing also from this and from other species in the absence of yellow hypopleural spots.

Holotype ♂, allotype ♀, one ♀ paratype, Nairobi, Kenya, one ♀ paratype, Kedong, Kenya, June, 1937, van Someren; larvae in fruits of *Loranthus dregei*, Ech. and Z.

Male, length and of wing, 4.5 mm.; female, length and of wing, 5.5 mm. HEAD yellowish brown, the flat occiput with darker spots, anterior half of frons yellowish, lower three-fifths of face and cheeks yellow, brown above and a brown spot below eye; bristles black, moderate, two inferior and two superior orbitals, ocellars strong; antennae brown, two-thirds length of face, arista pubescent. THORAX reddish brown, almost blackish, with indistinct, paler stripes on dorsum, where pubescence black with usual white band before and behind suture; humeri and broad mesopleural stripe yellow, pleural pubescence pale yellow, a little black on lower, dark edge of mesopleura, scutellum yellow, slightly swollen, pale pubescence; bristles normal; squamae blackish with black rims; legs brownish yellow, adjacent ends of hind tibiae and femora darkened, in female all femora blackish like thorax; wing: humeral band united to basal, only usual hyaline streaks and a moderate indentation on costa, basal band barely crossing sixth vein below, extending obliquely outward and broadly united to marginal so as to include upper cross-vein, cubital free, medial strong and united, only linear hyaline margins on costa. ABDOMEN strongly reddish, second segment with narrow silvery dusted hind margin, on fourth the hind three-fourths; genitalia reddish; base

of ovipositor short, 1.0 mm., about as long as segments 3, 4, and 5 together; blackish with black pubescence.

Trirhithrum teres, n.sp.

Very like *T. brachypterum*, Mro., differing in details of wing-pattern: the axillary cell is broadly hyaline at base and the end of the marginal band is largely extended over the end of the third vein, the large blackish spot there nearly reaching the fourth vein; the discal cell is narrower and the lower, outer corner more acute.

Holotype male and six male paratypes, Rabai, Kenya, 8/1937, van Someren; taken on bait.

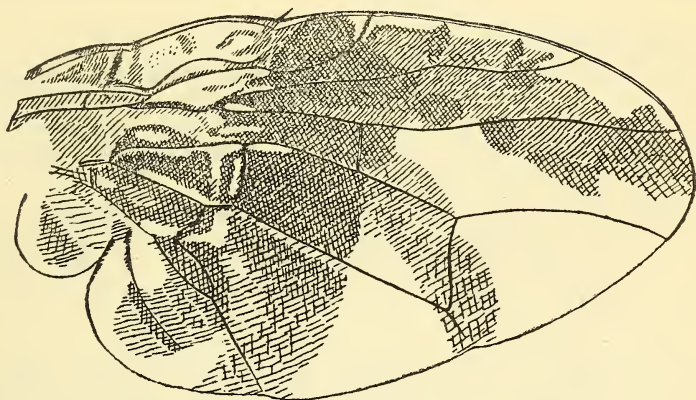


Fig. 1. *Trirhithrum teres*, n.sp. wing.

Total and wing length, 3.5 mm. HEAD: occiput rather flat and shining black above, not very prominent and yellow below; frons brown, reddish in middle, with irregular yellowish spots on sides and at vertex, ocellar dot black, slight black pubescence, two inferior and two superior orbitals, ocellars moderate; antennae two-thirds length of face, pubescence of arista about as wide as third antennal joint; face brown, a pair of yellow spots below antennae, and a yellow bar, narrow medially, across middle of face; palpi and proboscis brown. THORAX: dorsum, scutellum and post-scutellum shining black, lower parts more brownish; dorsal pubescence black, but white on the silvery dusted pattern which extends broadly across middle portion behind suture, sending a pair of stripes on dorso-central line to front edge, laterally stripes enclose on each side a large, rounded, shining black spot behind and just touching the suture, behind a short bar runs above the wing base, the hind half of the dorsum otherwise very lightly dusted, and with slight white pubescence on the hind margin; humeri yellow with a black spot; a narrow notopleural stripe yellow, and

across wing base yellowish; a tiny yellow spot at notopelural bristle and a pair just above, finally a small, round yellow spot on middle of mesopleura; pleural pubescence long, whitish, that on sterna, short and black; squamae yellowish with brown rims; legs: femora blackish brown, becoming paler distally; scutellum smoothly rounded, with some pale, slightly blackish pubescence, on top a pair of conspicuous, round, yellow spots and a pair, less conspicuous on sides, none at apex, four bristles; wing (fig. 1). ABDOMEN shining black, second segment with moderate posterior silvery band, on fourth the silvery band full length of segment in middle, half on sides, but with a pair of large, brown sub-median spots on anterior edge, fifth segment faintly dusted on middle; genitalia shining black.

Trirhithrum meladiscum, s.sp.

Very like *T. dimorphum*, Mro.,* the male havng also a deep black spot before the tip of the recurved sixth vein; the dorsum of the thorax is, however, shining black with practically no dust, and black pubescence in both sexes, and no yellow spots on the scutellum; the pattern at the wing-tip is also somewhat different.

Holotype ♂, allotype ♀, 3 ♂, 3 ♀ paratypes, Uplands, Kenya, October, 1937, van Someren; larvae in fruits of *Psychotria cristata*. 1 ♂, 1 ♀ paratype, Mobuku Valley, 7,300 ft. F. W. Edwards [Uganda, Ruwenzori Range, XII, 1934—1, 1935. B.M. E.Af. Exp. B.M. 1935, 203].

♂, length 3.25 mm., of wing 3.5 mm. HEAD mainly brown, not markedly shortened; occiput blackish above, not prominent below and with yellowish hairs; frons three-tenths width of head, widened anteriorly, blackish-brown with yellowish tinge, ocellar dot black, slight black pubescence, two inferior and two superior orbitals and strong ocellars; lunule short; antennae black with ferruginous tinge, especially first two joints, shorter than face, arista long plumose; face coloured like frons, flat. THORAX: dorsum, scutellum and post-scutellum shining black, the first with ferruginous tinge on sides and very slight dust, more apparent obliquely, and black pubescence; humeri pale ferruginous with a black spot; the lateral spots above the wing bases shining obliquely; scutellum somewhat convex with obscure yellowish spot on each side. Thorax otherwise pale ferruginous with yellow pubescence; chaetotaxy complete, four scutellars; legs pale ferruginous, tibiae and tarsi yellower; squamae yellowish. Wing (see figure of wing of *T. dimorphum* l.c.): basal band ending before fourth vein, but extended broadly and faintly into upper part of third posterior cell; marginal hyaline spots weak; medial band strong and reaching wing margin where it is faintly connected to end of marginal band. ABDOMEN short, shining black with black pubescence; a pair of

* Munro, 1934, *Bull. Ent. Res.*, **25**, 484, fig. 3, wing ♂.

moderate silvery dusted spots on hind edge of second segment and a very small pair on third; marginal bristles strong. Genitalia blackish ferruginous.

♀, frons orange-yellow in front, blackish on sides and behind; pleura and sterna strongly blackened as also coxae and femora, sutures and propleura more ferruginous; wing with basal band to hind margin as usual, apical pattern as in male. Submedian silvery spots on abdomen stronger, and there is also a pair on fourth segment. Base of ovipositor 0.5 mm., short and broad, rather flat in specimen, shining black with black pubescence.

Trirhithrum senex, n.sp.

Very like *T. dimorphum*, Mro.,* but with the dorsum of the thorax very strongly argenteous and the wing-pattern a little different.

Holotype ♂ and 4 ♂ paratypes, Rabai, Kenya, August, 1937; van Someren "caught on bait."

Length about 3.2 mm., of wing 3.2 mm. HEAD, proportions of length, height and width, 5:9:11; occiput moderate below, yellow with large black spot above, and yellow hairs; frons about three-tenths width of head, brown, yellowish on sides, vertical plates yellow, ocellar dot black, bristles black, two inferior and two superior orbitals, ocellars strong; lunule short; antennae dark brown, three-fifths length of dark brown face, arista long plumose, plumosity wider than third antennal joint and in three rows; genal bristle brown; palpi and proboscis yellow. THORAX: dorsum brownish black, the middle largely covered with thick argenteous dust and white pubescence, the front and sides shining black with black pubescence; humeri white with small brown dot; a narrow, white notopleural stripe and a single white hypopleural spot; pleura and sterna yellow, the former brownish above and behind merging into brown of hypopleural region; scutellum and post-scutellum black, former with strong, yellow, double spot on sides; lower squama pale yellowish, upper brownish; legs pale yellow, femora darker, straw yellow; halteres yellow. Wing (cf. fig. of wing of *T. dimorphum*, l.c.), hyaline spots in base stronger, but humeral and basal bands not as separated as in *T. viride*, Mro.; a deep black spot before the top of recurved sixth vein is present as in *dimorphum*; the basal band ends in the discal cell, not reaching the fourth vein; the marginal band extends broadly to the end of fourth vein and the medial complete but paler at its outer end; hyaline costal spots weak. ABDOMEN brownish black; second segment with weakly dusted hind margin; third and fourth with pair of silvery spots; genitalia brownish.

* Munro, 1934, *Bull. Ent. Res.*, **25**, 484, fig. 3, wing ♂.

FURTHER NOTES ON THE EARLY STAGES OF HETEROCERA BRED IN THE NAKURU DISTRICT.

By A. L. H. TOWNSEND.

SPHINGIDAE.

Hippotion eson, Cr.

FOODPLANTS.

Various Vitaceae.

LARVA.

When full fed is pale green, with darker linear spottings in the dorsal area. Faint darker dorsal and latero-dorsal lines. The lateral green is divided from the darker green of the latero-ventral area in a dentate line. The "eye-spot" is a dark green narrow ring, enclosing a yellow ring, which shades to darker yellow on its inner edge. It has a bright green centre, with five spots which are lighter green, dark ringed. The spot on the next segment is oval, buff-coloured, in a fine ring of green slightly darker than the ground colour.

There is a black V at the root of the "tail," which is rough, brown, white-tipped.

PUPA.

Is golden-brown, with conspicuous black spiracle spots, and a thin black ventral line. The whole case is sprinkled with fine dark spots, particularly on the wing-sheaths. Cremaster is a long fine central point, with fluted shank, and minute lateral teeth. Duration of pupal stage about two months.

Acherontia atropos, L.

This larva is too well known to need further description.

It is fairly plentiful in this district, its usual food being Sodom apple (*Solanum*). I have taken the larvae nearly full fed in January, March, April, and July. These larvae have always been the green or yellow forms. I have never seen the brown form frequently found in the English Fens.

Pupal stage lasts usually from two to three months.

Deilephila nerii.

This insect is apparently not common in this district, and though I have taken the imago flying I have not seen the larva at large. Those larvae that I have reared have been successfully fed on cultivated periwinkle (*Vinca*).

PUPA.

Is on earth-surface, in a large cell of dead leaves, etc., joined by large-meshed network. Its colour is light brown, much dusted and

speckled with black. Spiracle spots large, black. There is a black dorsal line on the thoracic segments, and a similar central line on the ventral side of abdomen. The terminal segment has on its dorsal side a short, stout, black cone, ending in two very short, slightly curved prongs. Pupal stage lasts from two to four months.

ARCTIIDAE.

Metarctia flavicincta, Auriv.

FOODPLANTS,

Various grasses, and a few low-growing weeds.

LARVA.

When full-fed is $2\frac{1}{2}$ " long, and stout. (A very large larva considering the size of the imago.) The thoracic segments are extensible to a very large degree. Colour, dark brown to black, with a pinkish tinge when extended. The body is clothed in fur, brown with a greyish tinge at the tips. The fur is long and silky, but sparse. It is mixed with shorter silvery hairs. It rises from prominent oval tubercles, set in transverse rings, the tubercles being slightly "staggered" in the rings. Head large, black and polished: the lobes slightly separated on crown. Ventral surface dark greyish-brown; with transverse black rings, emitting short bristles, on segments 5, 6, 11, 12, and 13. Legs long, black.

PUPA.

Is in a thin web cocoon. It is stout, black, shiny; with a reddish tinge where wing-sheaths meet abdomen. Terminal segment is a blunt dome with three patches of short separate light-brown hooklets on its dorsal side. There are also small patches of short spines, lateral and dorsal, on the abdominal segments.

NOTE.—The larvae live in hollows under stones, clods, etc. Since these homes contain cast skins and frass, they are presumably permanent habitations. The pupae are sometimes, but not often, spun up in them.

SATURNIIDAE.

Nudaurelia wahlbergi, Bsd.

FOODPLANTS,

Maerua (*muthigeo*) and pepper tree.

OVA.

Spherical, dirty-white with brown ring, laid in small batches.

LARVA.

When young, is rusty-red with short black spines. When full-fed it is 4" long. The head is black, semi-retractile, and has a few grey stubbly bristles. There is a horny black plate on Seg. 2, also bristly,

with a row of short black spines on its forward edge. The whole dorsal area is thickly covered with small flat greenish-yellow plates or scales, of various shapes, fitted closely together. The lateral area has the same scaly appearance, but the scales are less closely fitted. Between the segments the skin is rusty-red; and more of this colour appears on the lateral and ventral surfaces. An interrupted black dorsal line, widening into a black patch on the front part of each segment, has, on all segments except the last but one, a short black line at right angles to it. At each end of this short black line is a sharply conical black spine, with branched tip, having white bristles springing from it. Every segment from 3 to 11 carries a transverse half-ring of six such spines. On Seg. 12 there is one less; the two in the dorsal area being replaced by one stouter central spine. Spiracles are rusty-red. Irregular black lateral markings almost amount to diagonal stripes. Legs and claspers black, with white bristles. A black horny plate above the anal claspers. The larva has a very obese and wrinkled appearance, and is very sluggish.

PUPA.

Subterranean; black, very hard and horny. Pupal stage normally about $2\frac{1}{2}$ months; but sometimes much prolonged.

LASIOCAMPIDAE.

Pachypasa, sp. near *drucei*, B.-Baker.

FOODPLANT.

I have found the ova and young larvae on Acacia thorn, but have never been able to persuade them to eat it in captivity. They feed up very well on pepper tree.

OVA.

Laid in a conical pile on a twig, or on the bark of the trunk sometimes quite near the ground. They are stout barrel-shape, but the ends not quite flat. Colour white, irregularly spotted and splashed with bright brown. At the end, a black disc is surrounded by a white ring. Surface almost smooth, with very fine reticulation.

LARVA.

When full-fed is 3" long, stout, rather flattened. Ground colour brown with a yellow tinge, but in some cases the brown is almost purple. Dorsal line is lighter, and so are the other lines, but very faint. Dorsal area has complicated marblings of red-brown, and fine pale lines. Lateral area above claspers thickly clothed in dense but not very long fur, grey with a slight violet tinge. Segments 3 and 4 have transverse fringes of short yellow hair. When the larva moves, these segments disclose tawny-brown, or sometimes crimson cushions, which are normally sunk in transverse slits. The fringe on segment 3 has a short central extension at right angles to it, of the same hair. Each segment has interrupted irregular transverse bands of short

scanty hairs, pale yellow or white; and on a few segments these end in small pale violet tufts projecting horizontally from the latero-dorsal area. Other such tufts are on all segments on the spiracular line, above the longer fur of the latero-ventral area. There are distinct "lappets" over the legs, which are long and dark brown. Ventral area black with two orange lines. Head brown, furry. Claspers brown, black-stemmed. The larvae are gregarious.

PUPA.

Is in a thin but strong cocoon of harsh yellowish-brown silk; occasionally on a stem, but more usually in a thick bunch of leaves. Two or three are often spun up in one such bunch. Abdomen brown and black ringed, with short tawny fur on each segment. Wing-sheaths dull black. Rather longer fur on head. Terminal segment short and blunt. Cremaster, on the dorsal side, consists of a very large number of very short separate hooklets.

Duration of pupal stage is from two to three months. Complete life cycle five months.

Bombycopsis indecora, Walk.

FOODPLANTS.

Various low-growing plants, including "black-jack" and *Vernonia*.

OVA.

Laid in small patches of eight or nine. They are smooth, stout oval, pale pinkish-ochreous, much splashed and spotted with light and dark brown.

LARVA.

Is very furry, especially round the head and thoracic segments. There are conspicuous grey lappets over the legs; the first being black-spotted, the second having a thin black line, and the third a thick one. Head black, dorsal area dark grey with a narrow black central line. Lateral area much lighter grey with a pink tinge. The whole body is a mass of fine longitudinal lines, darker than the ground colour. Segments 3 and 4 have transverse slits, with red erectile cushions sunk in them. The slits have white crests on their hinder side. Latero-dorsal lines from head to second slit are pale buff. Along the latero-dorsal lines are ruby tubercles, each emitting a few dark bristles. The tubercles on 8, 10, and 11 are larger, and there is a blackish shade on the area from which they rise. A grey lateral tubercle on each segment emits fairly short grey fur. The fur pointing forward round the head is much longer. Legs yellow; claspers yellow as seen from below, grey from above. Ventral surface has a wide black central stripe. In the final instar the larva is usually umber brown, almost without markings. The fur is usually brown, sometimes grey. The white crests behind the thoracic slits persist, and there are indistinct dark grey latero-dorsal lines. The slit-cushions are crimson. Latero-dorsal

tubercles appear dark grey as seen from above, ruby-coloured from the side. Length about 3".

PUPA.

Is in a tough cocoon, long oval, nearly transparent, among leaves. Pupa is light brown, with darker wing-cases, and black spiracles. Abdomen covered with short pale tawny fur, slightly longer on the head. Cremaster consists of a very large number of short hooklets massed together in a roughly circular patch on the dorsal side of the terminal segment. Duration of pupal stage from three to five weeks. I have taken the moth flying in March and December.

Trilocha ficicola.

FOODPLANT.

Fig.

LARVA.

When young, is white with brown markings. Sits openly on a leaf and closely resembles a bird-dropping. When full-fed it is more than 2" long, slender, rough-skinned, but without bristles except for a few short ones around the anal claspers. Ground colour is sulphur yellow, with pinkish-brown markings. The lateral area (except that of the thoracic segments) has a reddish-brown tinge, and there is a red spot above each spiracle. Collar red-brown, with a yellow central line. Head yellow, retractile. Segment 3 is swollen, with a transverse wrinkle bearing three red dots. Segment 5 is slightly swollen, with red latero-dorsal patches. There is a reddish transverse wrinkle above the third pair of claspers. There is a "tail" (like that of the Sphingidae); very short, reddish-yellow, curved backwards. Claspers are ground colour, legs brown.

PUPA.

Is in a closely woven pinkish cocoon in a rolled leaf. The moth is on the wing in May and November.

LYMANTRIIDAE.

Orgyia vetusta, Hmps.

FOODPLANTS.

Castor oil and black wattle.

OVA.

Greyish-white; spherical, but slightly "dished" at the top, this part being surrounded by a brownish ring. Almost smooth, with very fine shallow depressions. The ova are laid both inside and outside of the cocoon.

LARVA.

Length when full-fed $1\frac{1}{4}$ ". The usual four dorsal "brush-tufts" are, in early life, dark smoky grey; the back two turn later to dingy

white; and in the final instar all four are either dingy white or (less commonly) canary yellow. These "brush-tufts" are wide and closely pressed together like a mat except when the larva is walking, when the spaces between them are seen to be black. In front of them the dorsal area is white as far as the collar, which is scarlet on black. Behind the "brush-tufts" the central stripe is black, with a grey area on each side, crossed by transverse rings of small scarlet tubercles. There is a conspicuous central scarlet stud on each of the segments 10 and 11. On segment 12 a dorsal "pencil"-tuft of blackish hair points backwards. The lateral area is yellow, with scarlet tubercles emitting fur that is mostly silvery-white. But that projecting backwards over the anal claspers is dark grey, while two blackish "pencils" project forwards from the collar. Under brush-tuft No. 1 is a white horizontal pencil, and under brush-tuft No. 2 is a black pencil with a white one behind it. Near the rear end of the larva is a smaller white horizontal pencil. Ventral surface yellowish; legs and claspers red. Head red-brown, mouth yellow.

PUPA.

Very short and stumpy; buff, with many black spots and markings. The cremaster, situated at the extreme dorsal edge of the flattened terminal segment, consists of a long narrow cone, surrounded by and tipped with a large number of separate hooklets. The cocoon (on leaf, stem, or any adjacent object) is of greyish-yellow silk; very small and compact; almost pear-shaped.

Duration of pupal stage is from nine to fifteen days.

NOTE.—I have bred large quantities of these larvae, in many different batches, on castor oil, the plant on which they were found. I was never successful in obtaining a single male, the entire result of every batch being wingless females. Males, however, assembled to, and mated with, these females. Subsequently I found masses of the cocoons and ova on black wattle, and from these I reared many imagines of both sexes. While, however, the males appeared quite normal, the females were in every case about half the size of those reared on castor oil.

Naroma signifera, Wehr.

FOODPLANT.

Fig, both cultivated and indigenous.

LARVA.

When full-fed is $1\frac{1}{8}$ " long, furry, flattened, very broad for its length. Ground colour varies, in different specimens, from white, through various depths of ochreous to light brown. There are latero-dorsal lines composed of minute black or dark brown dots, with a small light-yellow wart on each segment. On the two segments between legs and claspers four dorsal tubercles stand in square forma-

tion. On segment 2 is a horny, naked triangular plate, pale ochreous or white, with reddish lateral tubercles emitting long forward-pointing pencils of black hair. From the base of each of these tubercles a short black line curves inwards and backwards to the central line. A row of lateral tubercles emits dense whiteish silvery fur, with a few black hairs in it. Below the spiracular line the colour is pale greenish. Head large, white or flesh colour, speckled with darker. Claspers are flesh-colour. The larva sits quite openly on a leaf, and is very conspicuous.

PUPA.

Is among a few threads in a partly curled leaf. The same general colouration as the larva; very hairy, with a long double crest at head. Duration of pupal stage is about a fortnight. I have taken the moth in May, August, and December.

NOCTUIDAE.

Phytometra orichalcea, Fabr.

FOODPLANTS.

Very many low growing plants.

LARVA.

When full-fed is almost $1\frac{3}{4}$ " long, tapering considerably in front. Ventral claspers 2 pairs. Ground colour bright green. Dorsal stripe very dark green, with a narrow line of ground colour on each side. Outside this is, first, a rather irregular, fairly wide white line, and then a much narrower white line. Lateral line is yellow, with a very dark green upper edge shading off to ground colour. Ventral surface deep velvety green. There are sparsely scattered short white bristles over the body, rising from small pale warts. Legs black. Head shiny, green with black cheeks. A pale triangular plate over anal claspers.

PUPA.

Is in a fine silken cocoon among leaves. It is black, with a few yellow marks on abdomen. The tip of the leg-sheath is just detached from the body casing. Terminal segment short, with a short wrinkled protuberance on the dorsal side. This carries two short, stout points without hooks. Duration of pupal stage is about 15 days.

Achaea catella, Guen.

FOODPLANT.

Euphorbia crotonoides.

LARVA.

Until the last instar the larva is light grey, covered with a kind of bloom. It is minutely and thickly spotted with black. Head black, with Λ pattern in white; a white, almost circular patch on each cheek; and four white dots on crown. A few black dots in centre of back: twin black spikes on Seg. 12, each ending in a short bristle; and a black

spot above each spiracle. Legs black, ventral claspers brown, white-spotted. When the larva is looped, segment 6 discloses a black transverse band with four white spots in it. Ventral surface ground colour with a few black spots. A few short bristles occur over the anal claspers: otherwise the larva is smooth. Ventral claspers three pairs, but the front pair little used. After its last moult the larva completely changes its appearance. When full-fed it is $2\frac{1}{4}$ " long, greenish-brown, minutely dotted with black. A row of conspicuous black lateral spots above the spiracles, which are orange, ringed with black and white. Head brown, with large circular lemon-yellow patches on cheeks, and four pale dots on crown. On the face is a pinkish Λ outlined in white, with a white vertical line on each side. The first few segments have a faint dark dorsal line. The division between segments 5 and 6 has an orange shade, and when the larva loops a vivid crossbar of black and orange is disclosed. Behind this there is a faint dorsal pattern of black marks in an orange shade. This extends to Seg. 12, where are twin red-brown dorsal tubercles, ending in black bristles, and rising from a dorsal swelling. Anal claspers long, pale. Ventrals very fleshy, pale with many black dots, and a black oval ring, white-centred, on each. Legs red. Ventral surface paler, stained with orange, and with conspicuous black spots.

PUPA₄

Two larvae spun harsh silk spindle-shaped cocoons among the leaves. The others were all in similar cocoons, but covered with particles of earth, attached to stems at ground surface. The pupa is dark brown, finely granulated, covered with a greyish-white bloom that is thicker at the head end. Terminal segment is blunt, finely fluted, having a short cone on its dorsal side furnished with a number of stout, separate hooks. Duration of pupal stage is five weeks.

Prodenia litura.

FOODPLANTS.

Various low-growing plants, and cultivated tomato.

LARVA₅

When full-fed is $1\frac{1}{2}$ " long, stout, smooth. Ground colour is greyish- or greenish-ochreous. There is a chrome yellow dorsal line, and latero-dorsal lines of the same colour. Just above the latero-dorsal lines each segment has a pair of vivid black marks, the first three pairs and the last being larger than the others. The dorsal area between these marks is shaded with grey. The same grey appears in the lateral area. Spiracles are black, with a whiteish spot in front of, and just above, each. There is an indistinct orange spiracular line. Head small, brown, with a yellow Λ . Below the spiracular line is a band of ground colour, and the ventral surface is greenish grey of a darker shade. Segment 2 has a brown plate, which is crossed by the three yellow longitudinal lines.

PUPA.

Is subterranean. Duration of pupal stage about one month. The moth flies in October.

Tathorrhyncus homogyna.

FOODPLANT.

Indigophora.

LARVA.

Ventral claspers two pairs complete, one rudimentary. Length nearly $1\frac{1}{2}$ ", slightly tapering at rear end. Ground colour buff, with black lines and markings in the dorsal area which vary considerably in different specimens, and sometimes have an almost "hieroglyphic" appearance. In the latero-dorsal area is a grey stripe, composed of many fine dark lines: the lateral stripe below it is white, with a pink line inside it: below this is a dark velvety-brown stripe which shades off into the greyish buff of the ventral surface. The grey claspers have black spots. Head is large, buff, with sometimes a pink flush on crown. Face nearly white. But the various longitudinal lines of the body are faintly visible on the head and face.

This larva is larger and less tapered than that of *T. exsiccata*, and the head is larger. Otherwise, in their early stages they are very similar.

PUPA.

Is in a flimsy cocoon, covered with particles of earth. The cocoon is usually attached to a stem or twig on the ground surface. Pupal stage lasts about twenty-five days.

GEOMETRIDAE.

Psilocerea pulverosa, Warr.

FOODPLANT.

Clematis grata.

LARVA.

When full-fed $1\frac{1}{3}$ " long, stout, drab; sometimes with a faint pink tinge. A small double hump on Seg. 12, with a dark area and two black spots on its hinder surface; and a pair of small dorsal tubercles on each of the segments in front of this as far as Seg. 5. The pair on Seg. 6 are larger. These tubercles are very dark grey in front, lighter behind. From the head to Seg. 6 there is an indistinct latero-dorsal chain pattern in dark grey: on Segs. 7 and 8 this is also very faintly discernible. From this point to the hind hump the dorsal area is paler than the ground colour. There are slight "bulges" on the spiracular line, which is dark; and a black lateral dash on Segs. 2 to 4. A dark latero-ventral line is carried down the ventral pair of claspers, and behind them is a black spot. Ventral area ground colour with dark lines. Small dark warts all over the body, scattered, emitting very fine short sparse bristles. Skin generally rather rough and wrinkled.

Head grey, with two dark lines that extend over Seg. 2. The larva feeds by night.

PUPA.

Same general colours as larva. The terminal segment, which appears almost as if gilt, is pointed, and flattened dorsally and ventrally. Cremaster is of eight hooklets, two at the extremity being much longer and stouter than the others, which are arranged, three on each side, farther up the segment.

The pupa is among dead leaves, etc., on the ground surface, with no cocoon.

Colocleora simulatrix crenifera, Prout.

FOODPLANTS.

Castor oil and *Clematis grata*.

OVA.

Are laid in large flat patches on leaf surface. Almost true oval, but inclined to be more pointed at one end. Colour is a beautiful transparent green, with a slight blue tinge. Surface very smooth and shiny, no markings or sculpture visible.

LARVA.

The young larva is gregarious: dark chocolate brown, with five white transverse rings, and a thin white collar. During the day time it is very active, ascending and descending perpendicular threads stretched between two leaves; but it appears to feed only at night. When half fed there is a light brown dorsal patch over head and legs, and another over ventral and anal claspers. Those segments not having these patches exhibit the same colour laterally. Ventral area very dark, with a lighter central stripe of irregular width. When full-fed, the larva is $1\frac{3}{4}$ " long, fairly stout and fleshy. Skin rough, covered with small dark pustules. Head square, slightly lighter than ground colour, with a double white irregular vertical line. It is rather withdrawn into Seg. 2. The ground colour varies considerably in different specimens. Some are quite light grey, most exhibit different shades of brown, while some are almost black. The darker ones show practically no markings; but in most specimens lighter latero-dorsal lines are discernible, and faint darker dorsal patches, lozenge-shaped. There is a paler dorsal area on the last three segments, with two very small dark tubercles at its forward end. A pronounced lateral wrinkle, with one, or sometimes two white or yellow marks a little behind the legs.

PUPA.

Is underground, in a very flimsy case. It is light brown, stout. The terminal segment is dark brown, rather flattened, with roughly granulated surface; having on its dorsal edge a narrow cone terminating in two fine, sharp, diverging prongs. The pupal stage lasts for about three weeks: the complete life cycle from egg to egg averages just over three months.

Scopula nigrinotata, Warr.

FOODPLANT,

Oxygonum atriplicifolium.

OVA.

Nearly oval, but flattened at the end. Lemon-yellow, with raised longitudinal ridges that run the complete length of the egg, and project at the flattened end, forming a crenellated circle. Between them are minute cross-ridges. After a short time the ova turn to a bright carmine, and become dark grey just before hatching.

LARVA,

The young larva is very slender, grey or greenish, with a dark brown dorsal stripe. When full-fed, its length is 1" or slightly more. Tapers slightly from back to front. Skin minutely corrugated (transversely). Ground colour is green, grey or ochreous: very variable. Two extreme forms are as follows: (a) Pale green, with very faint dark dorsal line that becomes conspicuous on the last two or three segments. Head yellowish; spiracles black. No other markings. (b) ochreous to light brown. Dorsal line continuous, darker than ground colour, with a short dark dash on each side of it at the segment-joints. Round the head and legs the ground colour is lighter. There is a dark streak on the ventral pair of claspers.

PUPA,

Is in a slight web among leaves, or in a fragile cocoon among débris on the ground surface. It is bright yellow-brown. The terminal segment is swollen, and this swelling is darker than the rest of the abdomen. On the dorsal side it is prolonged into a stout cone, from the point of which proceed two long tapering prongs, slightly diverging. Separate hooklets, slighter and shorter than these prongs, spring from various points on the surface of the cone.

Duration of pupal stage is from 10 to 20 days. From egg to egg 80 to 90 days.

Semiothisa brongosaria, Walk.

FOODPLANT,

Acacia thorn tree.

OVA.

Blunt oval, pale green, covered with small hexagonal reticulation. Laid in thick clusters on leaflets and leaf-buds.

LARVA,

The young larva is green, with no obvious markings. When full-fed, it is 1" to 1 $\frac{1}{4}$ " in length, slender, smooth-skinned. Ground colour is greyish- or greenish-ochreous, the lateral area nearly white: the whole body thickly powdered with black spots. There is a bright yellow lateral splash on each segment. Ventral area pinkish. Head

grey, spotted with black, with a thin yellow collar behind it. Legs black, spotted with white.

PUPA.

Is in a flimsy cell under ground. It is slender, red-brown. Cremaster is very long and slender, polished, fluted. It terminates in two double-hooked diverging points.

Pupal stage lasts from 10 to 15 days.

Xylopteryx albimaculata, Warr.

FOODPLANTS.

Maerua ("muthigeo") and *Gymnosporia*.

LARVA.

When full-fed is $1\frac{1}{8}$ " long, stoutish, brown-drab. Head pale, with black spots, and a thin black collar. A fairly conspicuous dorsal pattern of diamond-shaped patches, one on each segment, lighter than the ground colour but with darker edges. These patches are more conspicuous on the first few and last few segments. A similar diamond pattern, but fainter, is in the lateral area. In this area also there are many small dark pustules. A pair of very small dorsal tubercles occur on segment 6, and larger ones on 12. There are a few short bristles scattered over the body. Ventral surface greyish, speckled with darker. Legs and ventral claspers pale, anal claspers of ground colour.

PUPA.

In a loose cocoon on ground surface, or between two leaves, is dark brown. Terminal segment pointed; cremaster on a long shank, terminating in a double hooklet with curved diverging points.

Epigynopteryx flavedinaria, Guen.

FOODPLANTS.

Castor oil, and many low-growing plants.

OVA.

Pale lemon-yellow, covered with hexagonal reticulation, and with very shallow longitudinal grooves. In small batches.

LARVA.

The young larva is bright green, rather polished. It tapers slightly from back to front. Lateral and ventral surfaces generally are paler than the dorsal. There is a white or yellow lateral mark above the legs: segment divisions are whiteish. A white streak, with black hinder edge, on the ventral pair of claspers. Legs dark, head pale, with black smudges on the cheeks. When full fed the larva is a rather greyish green; $1\frac{1}{3}$ " long; no longer polished, but rough, with tiny transverse corrugations. Two pairs of black latero-dorsal spots are on each segment. The last segment but one has a dorsal patch,

greyish-ochreous, roughly oval. An irregular brown central stripe on ventral surface. A few specimens have white dotted latero-dorsal lines, with a paler area between them. The larvae began to spin about six weeks after hatching.

PUPA₄

Is either in a rolled-up leaf, or among loose débris, dead leaves, etc., on the ground. It is grey or buff-coloured: the first few abdominal segments, between the wing-sheaths, having a strong greenish tinge. It is smooth and rather transparent. The abdomen is thickly sprinkled with dark dots, particularly the first few segments. The terminal segment is rather long, red-brown, pointed; flattened on the dorsal and ventral surfaces, with a distinct lateral ridge. It is very much wrinkled, and has a bunch of four long stalked hooklets proceeding from its extreme tip, and two other separate hooklets on either side, further up the segment. Pupal stage lasts about 15 days: complete cycle from egg to egg is nine weeks.

HYPENINAE.

Hypena jussalis.

FOODPLANT₄

Lantana.

LARVA₄

Length 1", ground colour transparent apple-green. Very much indented between segments, the divisions between which are of a lighter green than the ground colour. There are faint light latero-dorsal lines. Larva tapers considerably to either end. Head and body freely sprinkled with black dots emitting short pale bristles. Ventral claspers three pairs only. The larva lies extended, usually along the mid-rib of a leaf, and is very difficult to see. It wriggles furiously when disturbed, and falls without a thread.

PUPA₄

In a folded leaf. Shiny brown with dark green wing cases. Duration of pupal stage is 18 days.

Hapalia ablactalis, Walk

FOODPLANT₄

Buddleia.

LARVA₄

A very transparent-looking larva, tapering to both ends. When full-fed it is $1\frac{1}{16}$ " long. Rather yellowish, but the upper part of the body is dull, pale green, the dorsal part darker. Head very small, yellowish-brown, minutely spotted with black. Segment 2 similarly spotted. All the other segments have a half-ring of four delicately

drawn black circles, with a black dot in the centre of each : and behind these are two similar circles, one on each side of the dorsal line. The last segment and the anal claspers are not green above, but of the same yellowish colour as the lower half of the body. Ventral claspers (four pairs) very small, almost white.

The larvae eat holes all over the leaves, and lie along the midrib : or sometimes in a slight web among the flowers.

PUPA.

Slender, light brown ; in a very flimsy web in a folded leaf. Pupal stage lasts one month.

Osericana gigantalis, Hmps.

FOODPLANTS.

Grasses and many low-growing weeds.

LARVA,

When full fed is $1\frac{3}{4}$ " long, stout, smooth skinned, but with rings of short, stout pale spines rising from small black warts. Ground colour is dull black, without markings. Head black, rather shiny. The larvae live, often several together, under loose stones. They appear to make permanent homes, going out for food.

PUPA.

Is in a loose web-cocoon covered with bits of chopped grass, particles of earth, frass, etc., in the larval home. The pupa is black. The terminal segment has a short straight row of six separate hooklets set across its extremity near the dorsal side. Near the foot of this row are grouped a few other hooklets. There are short, fine, single spikes spaced out round each abdominal segment. Duration of pupal stage is from 15 to 20 days.

The following are supplementary notes concerning five of the species dealt with in the last issue of this journal.

Leipoxais compsotes, Tams.

The larvae feed also on pepper tree, kei-apple, and Maerua.

OVA.

Are laid side by side in long single lines on twigs. They are true oval, smooth, and shining. Colour bright mahogany, with a paler ring round the micropylar area.

Epizygaena xanthosoma, Jord.

The ground colour of the larva is very variable, ranging through every shade of grey. The stripes, in a full-fed larva, are sometimes hardly visible.

Amphicallia solai, Druce.

Alternative food—pepper tree.

OVA.

Laid in large patches on leaves. Pale butter-yellow, semi-spherical, with very finely reticulated surface.

Polymona modesta, Wkr.

OVA.

Are deposited in twos and threes on the leaves. Spherical, but slightly hollow at the top. In colour they are a dull greyish mauve, with a finely granulated surface.

Zamarada ochrata, Warr.

OVA.

Almost oval, but rather tapered to one end. Dull green, covered with close rows of tiny oval depressions. Laid singly on the edges of leaves.

PALMS OF KENYA.

By I. R. DALE,
Asst. Conservator of Forests.

The palms, together with the *Euphorbias*, Screw Pines (*Pandanus* spp.) and some of the *Dracaenas* (the "palms" of S.W. England) are, owing to their massive nature, seldom collected botanically, and the object in writing this article is not to produce an exhaustive botanical treatise, but to exhibit the gaps in my knowledge of the Kenya palms. Information as to the *Palmae* may be found in any book on the Monocotyledons and an account of the separate species is most easily obtainable in the "Flora of Tropical Africa." A few general facts of common interest, however, may not be amiss here.

Contrary to the belief of many English people (and novelists in particular) palms do not indicate lush tropical growth. Though they are almost confined to the tropics they usually occupy poor secondary sites, e.g. swamps, and are seldom found in "high forest." Though palms from the evidence of their inflorescences formerly branched, the modern species are now nearly all one stemmed, and the large size of the leaves is an adaptation to this monaxial condition. Palms, unlike *Dracaenas*, do not increase in girth by the formation of secondary tissues. Any increase in the diameter of the stem is due to the enlargement of the individual cells. This lack of secondary growth must be one of the main reasons for the monaxial habit. Once the growing point has been killed the whole plant usually dies.

The leaves of the palms are peculiar. The vestige of the original leaf may be seen in the scale at the top of the leaf stalk. The present leaf originates at the back of old leaf and as it develops becomes folded. A layer of tissue is cut off either at the top or the bottom (or sometimes on both sides). These strips die and are easily seen in an unfolding leaf. When the leaf is slit down to the base and intercalary growth takes place the pinnate type is formed: when it is only partially split and no intercalary growth is formed the palmate leaf results. The question as to whether the top or bottom layer dies is of some use in classification. If the pinnae are folded in a series of upright Vs they are known as induplicate; if in a series of inverted Vs reduplicate.

There are as far as I know only seven indigenous species of palms in Kenya. They are:—

Phoenix reclinata, Jacq.

Raphia ruffia, Mart.

Raphia monbuttorum, Drude.

Borassus flabellifer var. *aethiopicum*, Warb.

Hyphaene coriacea, Gaertn.

Hyphaene parvula, Becc.

Elaeis guineensis, Jacq.

The following key may be useful.

- | | | |
|---|---|-----------------|
| 1. Leaves fan shaped | 2 | |
| Leaves pinnate | 3 | |
| 2. Stem carrot shaped | | <i>Borassus</i> |
| Stem cylindrical, often branching | | <i>Hyphaene</i> |
| 3. Leaves more than 30 feet long | | <i>Raphia</i> |
| Leaves less than 30 feet long | | 4 |
| 4. Leaflets induplicate, stem slender, leaves green, 3 carpels free | | <i>Phoenix</i> |
| Leaflets reduplicate, stem robust, leaves tend to be greyish green, 3 carpels united | | <i>Elaeis</i> |

Phoenix reclinata, Jacq.

Mkindu (Swa.); Muchindu (Dig.); Mukindu (Kik.); Mchongana (Tav.), Kigangatchi (Tei).

This palm has a wide distribution in the Colony and occurs at sea level and as high as 7,000 feet altitude. It usually occurs in swamps or along river banks, but on the wet tops of the Bura Hills it appears in the scrub, though chiefly round stream sources. The palm forms dense thickets in places near Lake Jipe in the Taveta district.

The leaf midribs are largely used in basket making.

Raphia spp.

The *Raphias* have a very limited distribution in this country. That there are two species rests largely on assumption.

Raphia ruffia, Mart.

The Swahili and Taveta names of Mwaale may be confused with the Digo name Mwale or Muari (*Bombax rhodophagnolon*). This striking palm, which grows to about 35 feet, has leaves up to 50 feet or more long. The oval fruits are covered with shiny brown scales and look somewhat like a conifer cone. I have only seen this species in the swampy stream bottoms in the Ramisi valley and in the Kitobo and lower Lumi River districts at Taveta.

The raffia fibre is obtained from the unexpanded leaves. The midribs are used for roofing poles, doors, and ladders.

Raphia monbuttorum, Drude.

This species grows in Uganda and is more than probably the species which grows on the banks of the Yala in the Kakamega forest and along the Isiolo River north of Mt. Kenya. I know of no botanical specimens having been collected there. The "Flora of Tropical Africa" is rather vague as to the differences between the two species, and the recorded difference of the shape of the fruits does not read convincingly to me. Probably better material has been collected since the account was written.

Borassus flabellifer var. *aethiopicum*, Warb.

The Palmyra Palm; Mvumo (Swa. Mombasa); Mtappa (Swa. Lamu); Mugumo (Dur.).

This interesting palm with its large palmate leaves and a stem tapering from a bulge two-thirds of its height is not at all common and as far as I am aware is confined in Kenya to a narrow coastal belt. Specimens are most easily seen south of Mombasa, but it occurs in the Witu district and there is one specimen by the Station Road in Mombasa. Probably tappers of palm wine have reduced its numbers. I have not seen the palm between Mombasa and the Tana. It is found in the Eastern Province of Uganda.

Hyphaene spp.

The Doum palms are very confused as "many of the species have been described from imperfect material and are ill defined." Some species have been described mainly on the shape of the fruits which appear to me to be somewhat variable. I have only been able to recognise two species, *Hyphaene coriacea* and *H. parvula*.

Hyphaene coriacea, Mart.

Doum Palm; Mkoma (Swa.); Maramba (San.); Mchumbuli, Medi (Bon.); Irara (Tav.).

This palm, which grows to a height of 50 feet, may branch as many as four times and the branching though apparently dichotomous, is really axillary.

It is a very common palm on the Coast. It occurs occasionally in the Nyika country and is common near Lake Jipe at Taveta. The Doum palm in the Kitui district is probably this species.

Though its original habitat was probably forest and swamp edges it has been spread by elephants and humans, the fruits being edible, and is now widely spread in bush and open country. All the Doum palms are fairly fire resistant and if the upper parts get killed they appear to be able to sucker with ease. Hence the occurrence of extensive areas of Doum palm scrub.

The leaves are used for their fibre and for thatching, but their main use appears to be for palm wine tapping, the resulting drink being considerably stronger than that from the coconut palm.

The fruits of *H. coriacea* are described as turbinate (top-shaped) pyriform (pear-shaped), shallowly furrowed, broadest above the middle and flat at the apex. As would be expected the shape is not wholly constant. That the fruit is a possible source of vegetable ivory has been long known, but it has not been developed in Kenya though there is a large export from the Sudan and it is now being exploited by the Italians.

Hyphaene parvula, Becc.

Kikoko, Mkoko, Mkoma (Swa.).

This is a distinct species. It is a small, normally unbranched, palm growing to about 15 feet. I have only seen it on poor sandy soils south of Mombasa and near the sea shore at Kipini, and also on the burnt over grasslands on the Shimba Hills. Besides its small size and monaxial habit its fruits are distinctive. They are about two inches long and shaped like a cottage loaf.

H. crinata, Gaertn., which is an unbranched palm with oblong or obovate fruits (like a large potato) may occur but I have not seen it.

H. thebaica, Mart., which is a simple or branched palm up to 30 feet having obliquely ovoid and obscurely trigonous (3 angled) fruits, has been collected at Lamu, but I think it is probably an unusual form of *H. coriacea*. Though the argument is not sound, I cannot see from the point of view of habitat any reason for more than two species in the coastal belt. *H. thebaica* may be the species which occurs in Samburu and the Northern Frontier Province.

Elaeis guineensis, Jacq.

Guinea Oil Palm; Mposi (Tav.); Mchi'kichi (Swa.).

The Swahili name may be confused with that of *Bauhinia thonningii*, which is "Mche'keche" or with that of many of the *Papilionaceae*, which have the name "Mcheke'cheke."

This palm has a very limited distribution. It is not uncommon in the Ramisi valley and is scattered through S. Digo. Though often riparian it is not uncommon in drier sites. I have seen it in light forest at Taveta and have heard that it also occurs in the Sabaki valley near Malindi and near the Tana below Embu. If it occurs at Mkunumbi, between Witu and Lamu, its Pokomo name is Mchengwa, but its occurrence needs confirmation.

The palm is chiefly valued in Kenya for the fine strong fibre obtainable from the leaves, but the oil from the fruits is used for various purposes. The fruits compare very unfavourably in oil content with those of the cultivated West African form.

A number of exotic palms are to be seen in the Nairobi Arboretum and there are a few on the old Government Farm at Mazeras. There are only three exotics commonly grown in the country however:

Phoenix dactylifera, L., the Date Palm; Mtende (Swa.);

Areca catechu, L., Mpopoo (Swa.), the Betel Nut Palm; and

Cocos nucifera, L., Mnazi (Swa.), the Coconut Palm.

I shall be glad to receive information as to the occurrence and distribution of indigenous species.

SOME FIELD NOTES ON LEPIDOPTERA.

By B. BARTON-ECKETT.

The season, or rather the calendar year, opened with a trip to Uplands (Katamayo Forest) on 1st January. Conditions were ideal for collecting but the actual results were disappointing. A liberal supply of "bait" attracted only one specimen each of *Charaxes brutus* and *ansorgei*. The latter, a male, was taken by R. Saunders and proved to be in almost perfect condition. Two ova and two young larvae of the latter species were subsequently found and these resulted in three females and one male which emerged on 26th and 28th February and 8th and 12th March respectively, the average life-circle having thus taken approximately ten weeks. Little else of interest was taken on the occasion of this visit with the exception of a pair of *Neptis woodwardi*.

A further trip to Uplands was undertaken on 13th March with even more disappointing results. Despite a seemingly ideal day not a single butterfly visited the bait, and an extensive search of the food plant (*Bersama abyssinica*) produced only one larvae of *Ch. ansorgei*. This was in the very early stages and pupated on 10th April. Both sexes of *Acraea asboloplintha* were common together with a good sprinkling of *Planema (Bematistes) quadricolor leptis*.

Collecting in the forests round Nairobi has, on the whole, been disappointing though the Karura has produced some surprising records. The females of *Papilio dardanus* were very plentiful in both the Ngong and the City Park during January, but several bred families produced little of outstanding interest, there being in all cases an exceptionally heavy proportion of males. A form which seems well established in the City Park—*cenea* with deep orange in the underwing—produced only two females of this type, the remainder being typical *cenea* (5) and *hippocoon* (3). *Papilio jacksoni* is still to be met with in fair numbers in all the local forests but in both the Karura and the City Park it is, at the moment, easily outnumbered by *P. echerioides*, which is again making one of its spasmodic appearances. In 1931 this butterfly was extremely plentiful in all our local forests, and then, with the possible exception of a few stragglers, it almost completely disappeared until 1937. It would almost appear that *P. echerioides* is dependent on a wet season in order to establish itself locally as both 1931 and 1937 were "wet" years with semi-drought in the intervening period.

Pseudacraea boisduvali trimeni now seems firmly established in both the Karura Forest and the City Park, being particularly in evidence

during the early part of the year. I first took this beautiful insect in the Karura Forest on 15/7/37, which I believe was the first record for these parts. The occurrence locally is of interest; it is, of course, very common in the coastal area and again in Nandi. It would be interesting to know if it now occurs continuously from the coast to the Uganda border. The most striking local record is that of a male and female *Ch. druceanus* taken at bait by R. Saunders in the Karura Forest on 3rd April. On the 10th and 17th of the same month a male and female respectively were observed by the writer in the same locality. It is to be hoped that this fine insect will succeed in establishing itself locally.

Another new *Charaxes* record was made by the writer on 11th April when a female *fulvescenes* (form nr. *acuminatus*) was taken near bait in the Karura Forest. Over fifty ova were subsequently obtained from this insect. This sudden influx of species more generally associated with the Kikuyu Escarpment is of interest and would seem to suggest some partial migration or some local disturbance at their usual breeding ground.

Both *Ch. brutus* and *pollux* have been more in evidence than usual during the past few months and *Ch. xiphares nandina* has certainly been commoner in the Karura Forest than hitherto.

Several trips to the "plains" and one visit to the Ngong Escarpment were distinctly disappointing. Members of the genus *Teracolus* were little in evidence, *eris* being the only one met with in any numbers. On Easter Sunday search was made for the new Kenya race of *Alaena caissa* at the foot of the Ngong Escarpment, where the writer (and others) had taken it some months previously. This locality has unfortunately been recently swept by a grass fire and most of the undergrowth completely destroyed. There was no sign of the hoped-for *Alaena*, though I understand from Dr. van Someren that it is still to be obtained on the cliff face higher up.

Taken altogether, the first few months of 1938 have produced some interesting records though butterflies have not, on the whole, been particularly plentiful. Should the "long rains" come according to schedule there should be some good collecting to be had in July and August.

A NOTE ON THE CROWNED EAGLE (*SPIZAETUS CORONATUS*).

By J. T. OULTON.

A party of my men sent to the top of the escarpment in the direction of the Cherangani to try and shoot wild dogs and do some poisoning have now returned from this second effort. No success with the dogs but immense numbers of hyaenas poisoned.

They also failed to recover the skull of the reputed white hyaena : presumably it has been taken by the other hyaenas.

During their first trip they received complaints of a huge bird which had killed a young dog, several goat kids, and five fowls, and taken all to its nest. They were urged to do something about it and so they poisoned several pieces of meat and the owner of the lost fowls and goat kids undertook to climb the high trees and place the poisoned meat in the nest. As he was climbing the tree the bird suddenly appeared out of the distance and "zoomed" down on to the man's back embedding its claws in and tearing his shirt and continuously flapping and beating its wings against the man's back. With a frightened yell the man let go his hold of the tree and dropped to the ground and at the same time the bird released its hold of his shirt and flew off.

On their return I sent an additional man who could use a shot gun and they learnt that the bird had killed other goat kids and more fowls. They first obtained the services of a man noted for his ability in climbing trees and after he had fixed up a ladder system and thus visited the nest they patiently waited for the bird to put in an appearance and then shot it. After skinning it they rubbed in some salt. They also brought away the two eggs from the nest and these I have not ventured to blow. There is a possibility that they might hatch out.

On the boys overtaking me some three days afterwards I found a small number of maggots had invaded the skin and I have since dressed it daily with methylated spirit.

These men also shot a baboon known to have killed and eaten a good number of goat kids.

MUSEUM NOTES.

An expedition to the Chyulu Hills is at present being undertaken by the museum staff. This has been made possible by the generous donation of £500 by Mr. Campbell, part of which sum is being used to defray expenses.

Those taking part in the expedition are Dr. van Someren, Mr. Bally as botanist, and Mr. H. J. Allen Turner, who has been temporarily engaged as general field assistant. Two trained African bird-skinners and the necessary native staff are also employed.

All kinds of natural history specimens are being collected and it is hoped that this material when worked out will form an important contribution towards an ecological survey of the area. Mr. A. M. Champion and Dr. Hitchen (Government Geologist) have voluntarily assisted for a short period in carrying out a geological and topographical survey of the range. Great help has been given by Mr. C. G. MacArthur, of the Game Dept., regarding the safari arrangements.

The Chyulu Hills are an isolated, narrow range of volcanic origin about twenty-five miles in length. The ancient craters are filled with dense mist forest and the rest of the area consists of open grasslands. No collecting has previously been done in the area and it can be considered virtually unknown. The hills are situated in the Southern Game Reserve, twenty-five miles west of Kibwezi and forty-five miles east of Kilimanjaro.

It is hoped in due course as the collected material is worked out to publish a series of reports in this Journal.—Editor.

RECENT ADDITIONS TO FISH EXHIBITS IN THE MUSEUM.

The public galleries have been enriched with a fine specimen of a Sailfish, *Istiophorus gladius*, which was caught at Mombasa and presented by the Kenya Fish Supply Company.

The specimen is 8 feet long from the tip of the sword to the end of the tail and would weigh round about 160 lbs. when freshly caught.

The Sailfish belongs to the Family *Istiophoridae* of which there are three genera in the Indian Ocean; *Tetrapterus* (Spearfish), *Istiophorus* (Sailfish), and *Makaira* (Striped Marlin). There is another Family *Xiphiidae* (true Swordfish). No records have been received of the latter from our waters.

The principal external difference between the three genera is the size of the dorsal fin which, in the Sailfish, is very large, becoming smaller until in the true Swordfish (*Xiphias*) it is like that of a shark.

Their principal food are small fishes which they kill by going into a shoal and striking right and left with the sword. The dead and injured members are then picked up in a leisurely manner. The small specimens of about 40-60 pounds arrive off our coastline during October, but large specimens delay their appearance until January and leave at the end of March.

In size they reach 16 feet in length, but the average specimen caught by native fishermen is about 120 pounds.

Sailfish give every sport on rod and line.

Another addition is a Rhino Fish (*Barbus rhinoceros*) taken from the Athi River and presented by Mr. Playford.

This fish is very like the Indian "Mahseer," but can be distinguished from all the other *Barbus* of Eastern Africa by the pronounced horn which is so evident when the lips are drawn out.

This fish can attain 35 pounds in weight, and is also reported from the Tana River, although no specimens have, so far, been received.

Its food would appear to be small fish of the species *Barbus*, the Athi River prawn (*Palaemon lar*, F.), and the Fresh Water Swan Mussel.

The smaller specimens can be taken with a fly, but the large fish take a small *Barbus* drifted down the heavy water at the head of the pools or by ledgering in deep water. They can be seen feeding in the big pools late in the day, chasing the bait in various directions. Some specimens, when hooked, fight well, while others give up after

one long run, but all take a delight in finding every under-water obstruction in a river.

The last addition is a specimen of the Elephant Snout Fish (*Mormyrus tenuirostris*). This specimen also came from the Athi River and can be immediately recognised by its long flexible snout which is pushed into the soft mud when feeding. Mud, worms, under-water insects, etc., are sucked up and the parts digested. In life this fish is covered with a heavy coating of slime which is said to have poisonous qualities, and in addition electrical impulses are generated when touched.

This fish is usually caught when fishing with a worm for *Tilapia*, and they give little or no sport when hooked.

One species from the Congo is said to be most delicious eating, but the same cannot be said for those from the Athi River.

HUGH COPLEY.

EAST AFRICA AND UGANDA NATURAL HISTORY SOCIETY.

TWENTY-SEVENTH ANNUAL REPORT, YEAR ENDING DECEMBER 31ST, 1937.

The Report of progress for the year 1937 deals with the activities of the Society in its dual capacity as an organisation for the study of Natural Sciences and as the instrument by which the Memorial to Sir Robert Coryndon is developed and maintained. The Society, as such, has continued to prove of interest to the public of Eastern Africa and overseas Institutions, as evidenced by the steady increase in membership; its Museum has proved a greater attraction than ever, as shown by the number of visitors to the Institution.

As in former years, the first portion of this Report will deal with matters connected primarily with the Society.

MEMBERSHIP.

The total number of members of all classes is just under 300; of these, some twenty-eight were elected during the year, which more than compensated for the inevitable number of resignations. His Excellency Sir Robert Brooke-Popham was elected a Patron of the Society, and Mr. W. H. Campbell of New York was elected an Honorary Life Member.

The income derived from subscriptions was over Shs. 7,000/- and Shs. 1,000/- more than budgetted for, and clearly indicates that public interest is maintained. Apart from income derived from subscriptions, two monetary donations were made to the Society: Rear Admiral Lynes, C.B., subscribing the sum of £100, while a sum of £500 towards the botanical work of the Society was given by Mr. W. H. Campbell of New York.

PUBLICATIONS.

Curtailement in the number of Journals issued during the year was resultant on a number of factors not the least being the calls on the time of the Honorary Secretary consequent on preparation of evidence for the "Committee of Enquiry" and subsequent negotiations with Government; in addition, a very considerable portion of the publication vote was used in discharge of printing liabilities contracted in 1936. One double number of the Journal was published, and in addition, an important Special Supplement containing original descriptions of new species of Trypetidae (fruit flies) by H. K. Munro, based on material bred out in the Museum Laboratories.

One public lecture was arranged and delivered by A. M. Champion, Esq, C.M.G., on his trip across Africa from Dakar to Nairobi.

The talk was illustrated throughout by Ciné films, many in colour, and attracted a large audience. A special exhibition of rhino pictures and films was shown during the course of two weeks to augment the funds required for new habitat groups.

Private demonstrations have been a feature during the year whilst talks on Archaeological matters, by Dr. Leakey, have proved as popular as hitherto.

STUDY COLLECTIONS.

Accessions to the study material, in several important divisions, have been maintained. As always, the Entomological section benefited to the greatest extent. Outstanding contributions were made by Messrs. MacArthur, R. E. Toker, Blom-Bjorner, Allen Turner, A. L. H. Townsend, A. F. J. Gedye, G. van Someren, the Department of Agriculture, Kampala, and the Curator.

Mr. Townsend's donations of bred series of Moths, complete with full data on their metamorphosis, is of particular note and value, whilst the accessions to the collection of Diptera, mainly as the result of continued research on Trypetidae, has resulted in many new species and new records for Kenya. The laborious work of identification and description has been carried out entirely by Mr. H. K. Munro of the Department of Agriculture, Pretoria, without whose willing assistance much of the material would remain undetermined. We record our great appreciation of this arduous work. Sir Guy Marshall of the Imperial Institute of Entomology, and members of the Division of Entomology, British Museum, rendered, as hitherto, invaluable service in the determination of many thousands of insects submitted to them. The assistance given by the Imperial Institute of Entomology is the more appreciated, in view of the fact that the Society's collection is not part of a State organisation, and the privilege extended to us, as a private organisation, can be taken as indicative of the value of our material to entomological science.

We desire to record our thanks to Mr. Gedye for his honorary work in curating the collections of Coleoptera, etc.

The Ornithological collections were augmented by series donated by Capt. Pitman of Entebbe, and Mr Hopkins of Kampala.

The Reptile section received valuable additions presented by Mr. Fuchs, from the South Rudolf area, all fully determined by the British Museum. Botanical material has increased, mainly as the result of specimens collected in connection with the work on fruit flies and their host plants. The Forestry Department of Kenya donated two collections of named material.

LIBRARY.

As the result of continued co-operation with overseas Institutions, the Library has received an increase in publications both as donations

and as the result of exchange of journals. To maintain this essential contact, we were able to engage the services of Mr. Gedye as Librarian at a very small honorarium. It is to be greatly regretted that financial stringency did not permit of a full-time Librarian, and thus the essential work of subject card-indexing has remained in abeyance for yet another year.

GENERAL ACTIVITIES.

The reference collections of the Society have been made use of by several Government Departments and visitors from overseas. Reports on, and determination of material sent in from various sources has occupied a considerable amount of the Curator's time, and the study material has proved its value to an increasing degree. Assistance in the field and laboratories was rendered to Admiral Lynes and Mr. R. Wood in their investigation into the group of Grass Warblers. Miss Cynthia Longfield, of the British Museum, made use of and gave assistance in work, on the collection of Odonata.

MUSEUM PROGRESS.

No outstanding additions were made to the exhibited material during the year; nevertheless, in practically all divisions some additional material was exhibited. Of particular public interest was the addition of a mounted lion donated by Mr Mike Cottar, and prepared by Messrs. Jonas Bros. of New York. This exhibit has filled a long-felt want. It is not out of place to here refer to the magnificent pair of elephant tusks secured for the museum as the result of His Excellency the Governor's personal interest in the Institution. These tusks, weighing 172 and 170 lbs. respectively, remain Government property, deposited on permanent loan to the Museum. A new Habitat Group was started towards the end of the year. This was made possible by the donation from Admiral Lynes to which reference has already been made. The Archaeological material was augmented and re-arranged by Dr. and Mrs. Leakey, and this now stands as the finest of its kind in any museum.

We record our thanks to all those who have made donations and assisted in building up the Museum during the year.

VISITORS.

The number of visitors is always an index of the degree of interest taken in the Museum by the general public, and up to the end of the year a total of 5,099 was recorded. This compares favourably with the figure for 1936, viz. 3,906, and 2,200 in 1935. A noteworthy feature of this influx is the very considerable proportion of non-Europeans, both Indian and Africans, who visited the institution. A notable increase in the number of pupils of European, Indian, and

African schools is recorded, and every facility was given in the way of free admission and explanatory talks. The income derived from admissions was just over Shs. 2,000/-, thus 3,000 visitors were admitted free.

FINANCE.

As anticipated in the Report for 1936, we are pleased to record that the two principal contributing bodies, viz., the Government and the Municipal Council of Nairobi, both made increases in their grants during 1937. We record our appreciation of this increase, nevertheless, it is incumbent on us to press further for a proper recognition of the Museum as of cultural and scientific value.

Closely connected with finance is the question of future organisation of the Museum as part of the Coryndon Memorial. Members will recall that consequent on certain criticisms made during the year, at the Annual General Meeting of 1935 we passed a resolution calling on Government to appoint a "Committee of Enquiry." The Committee was appointed by His Excellency in April, 1937, and evidence was taken during June. The Report was published in October, and formed the basis of discussion at the Special General Meeting of October 29th, when the meeting approved of certain fundamental evidence put before the Enquiry Committee by your representatives, Messrs. Daubney, Leakey, Gedye, Copley, Slade (Hon. Solicitor), and the Honorary Secretary. This same sub-committee, augmented by Messrs. Gardner and Bompas, was empowered to negotiate with Government as to the basis on which the assets of the Society could be assigned.

As the result of considerable discussion and investigation, your sub-committee submitted a memorandum stating emphatically that the assets would be made available such time as the minimum recurrent revenue reached a figure of £2,090 and other fundamental desiderata were provided for. The result of discussions with Government is reflected in the amount of the Government contribution for 1938 as provided for in the Estimates, viz., £1,000.

Government has approved of the recommendations relative to constitutional re-organisation, advocated by the Society, and embodied in the Report of the Enquiry Committee. This re-organisation will provide for the establishment of a legal Charter under which a Board of Trustees will be appointed, and a Board of Management will be nominated; the Board of Trust will assume control of the Museum, when the conditions stipulated by them have been fulfilled. During the interim period which must necessarily elapse before the required machinery can be brought into being, your Executive has agreed to carry on the Museum on a minimum contribution, from outside the Society's revenue, of £1,700. In the meantime, it is Government's intention to draft the necessary legislation, and furthermore, Govern-

ment has agreed to a proposal to bring into being the nominated Board of Management, without for the time being any official status, to further investigate the requirements of the institution and to advise on the matter of adequate legislation.

The Society will thus, eventually, surrender control of the Museum and its scientific collections, but ample representation on both the Board of Trust and the Management Committee is assured. The Society has nursed this Museum from infancy to a state of growth, when, for economic reasons, the State must assume control. We desire to place on record our appreciation of the personal interest taken by His Excellency throughout the negotiations.

The Balance Sheet and Financial Statement for the year indicate that the Society is in a strong position regarding assets, and that its activities are conducted on sound economic lines.

In conclusion, we wish to place on record our appreciation of the assistance received throughout the year, both financial and practical, in all branches of the Society's activities. We tender our special thanks to Mr. Humphrey Slade for advice and opinions on legal matters connected with the re-constitution of the Museum; and to Mr. Gould for services as Honorary Treasurer.

V. G. L. VAN SOMEREN,
Hon. Secretary.

BALANCE SHEET AS AT 31st DECEMBER, 1937.

| CAPITAL & LIABILITIES. | | ASSETS. | |
|--|---------------------|-------------------------------------|---------------------|
| GENERAL FUNDS. | | CASH ON HAND. | |
| Surplus, as per Account attached | Shs. Cts. 66,189 92 | At Bank ... | Shs. Cts. 10,219 19 |
| SUBSCRIPTIONS PAID IN ADVANCE | 245 00 | On Hand ... | 44 32 |
| | | On Fixed Deposit ... | 200 00 |
| UNEXPENDED DONATIONS FOR SPECIFIC EXPENDITURE. | | | 10,763 51 |
| Admiral Lynes ... 2,000 00 | | SUNDRY DEBTORS. | |
| Less amount expended 1,397 93 | | Subscriptions ... | 438 00 |
| | 602 07 | Sundry ... | 114 00 |
| Prince of Wales ... 500 00 | | | 552 00 |
| W. D. Campbell ... 10,000 00 | 11,102 07 | GENERAL ASSETS (as per Schedule 1). | |
| | | As per last Balance Sheet ... | 59,936 92 |
| SUNDRY CREDITORS. | | Additions since ... | 3,397 93 |
| Gill & Johnson ... | 100 00 | | |
| | | Less Total depreciation | 63,334 85 |
| | | | 2,687 37 |
| | | JOURNALS OF THE SOCIETY | |
| | | (As per Schedule 2) | 60,647 48 |
| | | | 5,674 00 |
| | Shs. 77,636 99 | | Shs. 77,636 99 |

We have prepared the above Balance Sheet from the books and papers of the East Africa and Uganda Natural History Society and from information supplied to us, and certify same to be in accordance therewith.

NAIROBI,
11th January, 1938.

For GILL & JOHNSON,
(Signed) L. GILBERT.

REVENUE & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31st DECEMBER, 1937

| EXPENDITURE. | | Shs. Cts. | REVENUE. | | Shs. Cts. |
|---|-----|-----------------------|------------------------|-----|-----------------------|
| Salaries and Wages | ... | 17,237 22 | Municipal Grant | ... | 8,000 00 |
| Bank Charges | ... | 53 85 | Government Grant | ... | 8,000 00 |
| Insurance | ... | 309 10 | Miscellaneous Receipts | ... | 311 65 |
| Subscriptions for Periodicals | ... | 487 75 | Subscriptions | ... | 7,097 84 |
| Light, Heating, and Water | ... | 699 15 | Visitors | ... | 2,010 41 |
| Miscellaneous Expenses and General Upkeep | ... | 970 39 | | ... | |
| Audit Fees | ... | 100 00 | | ... | |
| Postages and Telephones | ... | 940 47 | | ... | |
| Stationery | ... | 174 00 | | ... | |
| Free Issues of Journals | ... | 3,530 00 | | ... | |
| Bad Debts (on subscriptions) | ... | 250 00 | | ... | |
| Balance, carried to Capital Account | ... | 667 97 | | ... | |
| | | <u>Shs. 25,419 90</u> | | | <u>Shs. 25,419 90</u> |

Schedule 1.
SCHEDULE OF ASSETS AND DEPRECIATIONS.

| | As per last Balance Sheet. Shs. Cts. | Additions during year. Shs. Cts. | Depreciation for year 1937. Shs. Cts. | Nett value. Shs. Cts. |
|------------------------------|--|--|---|--------------------------|
| Aviary | ... | — | 8% 132 48 | 1,523 52 |
| Botanical Cabinets | 1,656 00 | — | 10% 50 94 | 458 46 |
| Cabinets—General | 509 40 | — | 10% 1,070 55 | 9,634 95 |
| Metal Show Cases | 10,705 50 | — | 2% 285 50 | 13,989 50 |
| Wooden Show Cases | 14,275 00 | — | 10% 192 73 | 1,734 55 |
| Furniture | 1,927 28 | — | 10% 826 30 | 7,436 72 |
| Metal Fittings | 8,263 02 | — | 2% 14 11 | 691 49 |
| Electric Heaters | 705 60 | — | 10% 23 76 | 213 84 |
| Instruments and Apparatus | 237 60 | — | 5% 54 88 | 1,042 87 |
| Miscellaneous Assets | 1,097 75 | — | 10% 36 12 | 325 10 |
| Books and Library Account | 361 22 | 2,000 00 | — | 22,198 55 |
| Admiral Lynes' Habitat Group | 20,198 55 | 1,397 93 | — | 1,397 93 |
| | Shs. 59,936 92 | 3,397 93 | 2,687 37 | 60,647 48 |

Schedule 2.
JOURNALS OF THE SOCIETY.

| 1937. | Shs. | Cts. | Shs. | Cts. |
|---|------|----------|---------------|------|
| Jan. 1. Balance, as per last last Balance Sheet | ... | ... | 11,819 55 | |
| Dec. 31. Cost of printing further Journals | ... | ... | 2,704 12 | |
| Less Sales | ... | ... | 14,523 67 | |
| Free Issues to Members | ... | 604 67 | | |
| Used in exchange for Library additions | ... | 3,530 00 | | |
| | ... | 2,000 00 | | |
| Less Depreciation | ... | ... | 6,134 67 | |
| | ... | ... | 8,389 00 | |
| | ... | ... | 2,715 00 | |
| | | | Shs. 5,674 00 | |

CAPITAL FUND ACCOUNT.

| DEFICIT. | | SURPLUS. | | | |
|-------------------|--|----------------------------------|------------------|---|------------------------------------|
| 1937. Dec. 31. | Adjustments on last year's accounts Balance, as per Balance Sheet ... | Shs. Cts. 185 30 66,189 92 | 1937. Jan. 1. | General Funds—as per last Balance Sheet ... Less Depreciation of Assets for the year ... | Shs. Cts. 69,711 69 5,402 37 |
| | | | | Add Excess Income for the year ... | 64,309 32 667 97 |
| | | | | Add Admiral Lynes' Donation— Amount expended on Fixed Assets to date ... | 64,977 29 1,397 93 |
| | | Shs. 66,375 22 | | | Shs. 66,375 22 |

ADMIRAL LYNES' DONATION.

| | | | | | |
|-------------------|--|---------------------------------|-------------------|-----------------|-----------------------|
| 1937. Dec. 31. | To Fixtures for Habitat Group ... Balance, carried over ... | Shs. Cts. 1,397 93 602 07 | 1937. Dec. 31. | By Donation ... | Shs. Cts. 2,000 00 |
| | | Shs. 2,000 00 | | | Shs. 2,000 00 |

MR. W. D. CAMPBELL—DONATION ACCOUNT.

| | | | | | |
|-------------------|------------------------------|----------------|-------------------|-----------------|----------------|
| 1937. Dec. 31. | To Balance, carried over ... | Shs. 10,000 00 | 1937. Dec. 31. | By Donation ... | Shs. 10,000 00 |
|-------------------|------------------------------|----------------|-------------------|-----------------|----------------|

PRINCE OF WALES' DONATION.

| | | | | | |
|-------------------|------------------------------|-------------|-------------------|-----------------|-------------|
| 1937. Dec. 31. | To Balance, carried over ... | Shs. 500 00 | 1937. Dec. 31. | By Donation ... | Shs. 500 00 |
|-------------------|------------------------------|-------------|-------------------|-----------------|-------------|

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